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TWO NEW VICTORIAN SYMPHYLA OF THE GENUS *HANSENIELLA.*

By O. W. Tiegs, D.Sc.

(Department of Zoology, University of Melbourne.)

(Figs. 1-2.)

Of the two species which are here described, one is the subject of a forthcoming embryological memoir, while the second will be referred to incidentally in the same work. As there appears to be no published record of either species, a taxonomic description is required. This forms the substance of the present paper.

Although Symphylids are easily obtainable in Australia, even in large numbers, if sought for in their appropriate environment, there are only few accounts of their occurrence here, while the commonest genus, *Hanseniella,* does not seem to have been recorded at all. Attems (2) described from Western Australia, in 1911, under the name *Scutigerella indecisa,* a form which may prove to be a species of *Hanseniella,* Bagnall's (3) definition of that genus having not then been given. More recently Tillyard (6) refers under the name *Scolopendrella* sp. to a form which, from the presence of coxal styles, clearly belongs to another family of Symphyla—the *Scutigerellidae,* and which, from the dimensions given, is probably the common *Hanseniella agilis* here described.

In the following taxonomic description I have closely followed the method of Hansen (4), since direct comparison with his species can only be made on those characters to which he specifically refers. The terminology is also that of Hansen.

Family **SCUTIGERELLIDAE** Bagnall, 1913.

Genus HANSENIELLA Bagnall, 1913.

Hanseniella agilis, sp. nov.

(Fig. 1, A-F.)

Length 6-6·5 mm. when fully grown; the full number of legs first appears in animals 4·2 mm. long.

Head.—About as broad as long, measuring in large adults 0·55 mm. in diameter; clothed with numerous equally spaced setae; the longest lateral setae equal in length to, and sometimes even considerably longer than, the breadth of the proximal antennal joints; "central rod" not forked.

Antennae.—In large adults there are as many as 43 antennal segments; in incompletely grown individuals the segments are fewer, even in animals that have attained the full complement of legs; e.g., in an individual measuring 4·8 mm., only 32 antennal segments were present. Setae on inner side of primary whorls not longer than those on the outer side. The

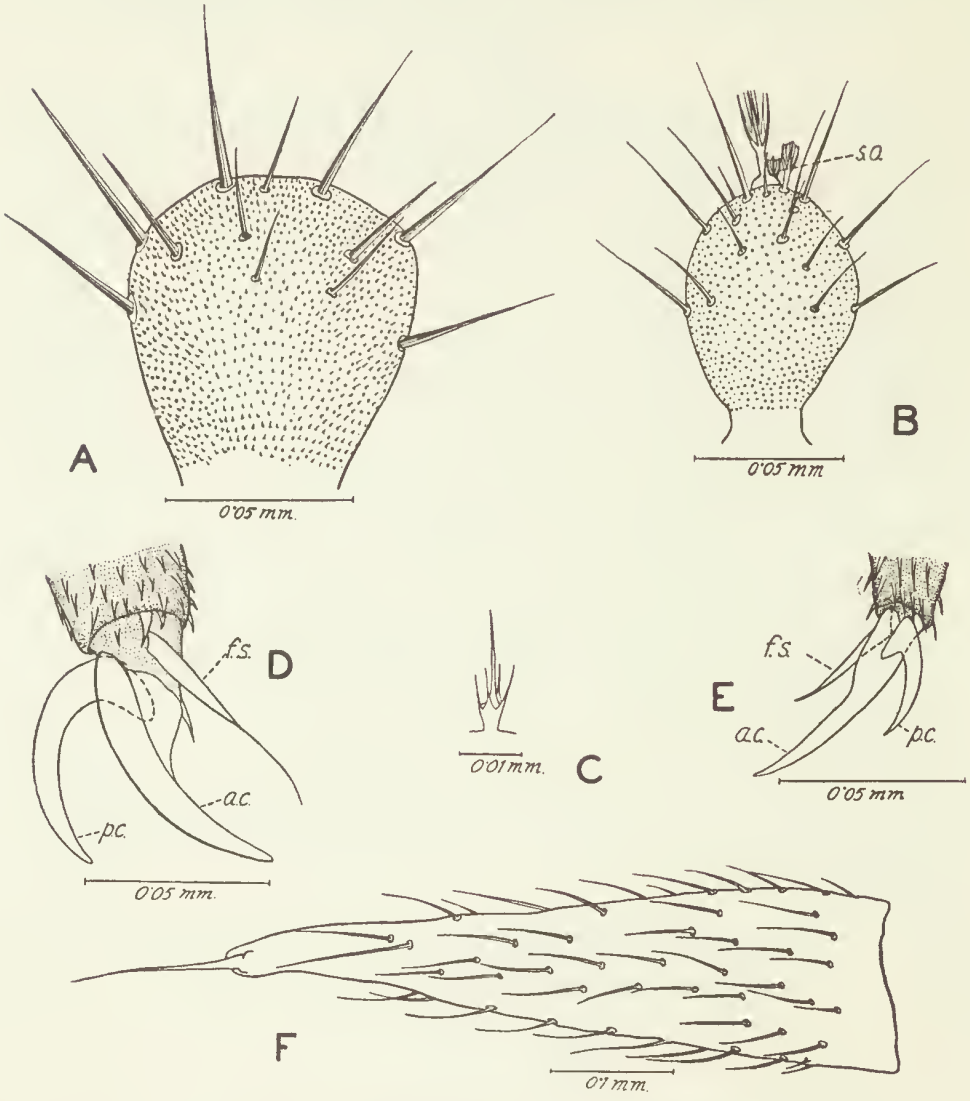

FIG. 1. HANSENIELLA AGILIS sp. nov.

A.—One of the distal antennal segments.
B.—Terminal antennal segment, showing the sense-organs.
C.—Single sense-organ, from one of the proximal antennal segments.
D.—Claws of right hind leg, anterior view.
E.—Claws of the right front leg, posterior view.
F.—Cercus.
a.c., anterior claw; *f.s.*, "front seta"; *p.c.*, posterior claw; *s.o.*, sense-organ.

secondary whorl begins on the lower side of the seventh or eighth segment, first appears dorsally on about the fifteenth, and is well developed by about the twenty-first or twenty-second. A third whorl begins, on the lower side, on about the seventeenth segment. On the more distal segments the individuality of the whorls tends to become more obscure (cf. Fig. 1A). Except for an occasional diminutive seta, the setae of the whorls are approximately equal in length, measuring about three-fifths the thickness of the basal antennal segments. Terminal segment provided with three stalked sense-organs ("striped organs"), of which two are small, the third nearly twice as large, and with a broad base (Fig. 1B). The large sense-organ seems, on close examination, to consist of a central spine surrounded by a ring of six lesser spines. In addition to these sense-organs on the terminal segment, there is a sense-organ of similar type on each segment from the third onwards. Under high magnification it is seen to consist of a long central spine surrounded by a ring of four lesser spines (Fig. 1C). Comparable organs have been described by Imms (5) from *H. (Scutigerella) subunguiculata.*

Scutes.—The first two scutes convex on their posterior margin; from the sixth backwards they are gently indented. On each scute except the fourth, seventh, tenth and fourteenth, a single pair of very enlarged outwardly directed lateral setae. The enlarged setae of the first scute nearly three times the breadth of the basal antennal joints. Following Hansen, I have reckoned the scute of the second leg-bearing segment as the first, the diminutive scute of the first segment being customarily excluded from the series. It is devoid of a large lateral seta.

Legs.—On the last leg the tarsus is five times longer than thick. "Metatarsus" and tarsus each with eight setae in the outer dorsal row. On the "metatarsus" the most distal seta is the largest; it measures more than half the thickness of the "metatarsus." The anterior claw (Fig. 1D) of the last leg is slightly curved, and forms at its base a broad blade which tapers sharply one-third the length of the claw from its basal end. The posterior claw more curved, being two-thirds the length of the other. "Front seta" unusually long, being nearly as long as the anterior claw; its basal half broad and blade-like, its distal half tapering into a thin filament.

On the first leg the anterior claw (Fig. 1E) is rather less curved than on the last leg, and the basal blade-like portion is less pronounced. Posterior claw curved and about half the length of the anterior claw; basal portion unusually sharply demarcated. "Front seta" robust and a little longer than the posterior claw.

Cerci.—(Fig.1F). Their length from four to five times their thickness. Clothed with numerous relatively small setae, of about equal size, except that they enlarge a little towards the apex. At the apex itself is a single enlarged seta, a little longer than the thickness of the cercus at its base.

Habitat.—Belgrave, Marysville, and Otway Range, Victoria. The animals occur under stones and in decaying vegetation; well-decayed trunks of tree-ferns (*Alsophila, Dicksonia*) are especially favourite haunts, and they can usually be obtained in numbers by breaking up the rotting stems. A moist but not wet environment is always selected.

Type in National Museum, Melbourne.

Of the described species of *Hanseniella* the present species seems to resemble most closely, though it is clearly not identical with, a form described by Archey (1) from New

Zealand, and regarded by him as identical with *Hanseniella (Scutigerella) caldaria* Hansen, from South America. Certain differences between the two forms were, however, observed, notably in regard to size, number of antennal segments, and other points. In so remarkably homogeneous a group as the Symphyla the differentiation of species, when direct comparison of types is not made, must be a matter of uncertainty, and it is not improbable that the New Zealand form is a species distinct from the South American.

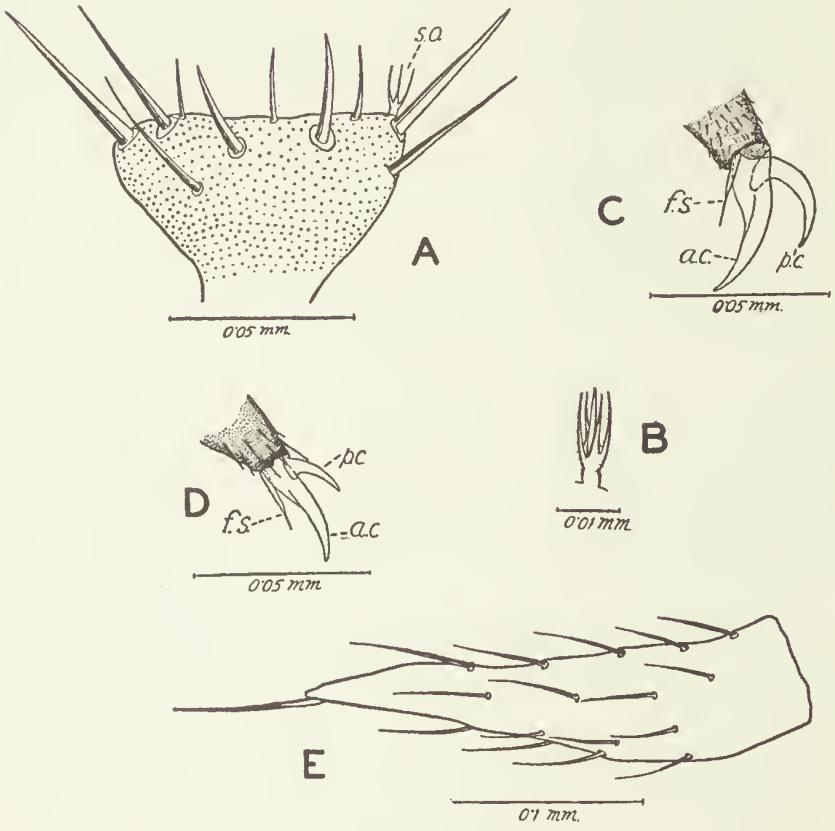

FIG. 2. HANSENIELLA MINOR sp. nov.

A.—One of the distal antennal segments; sense-organ visible.
B.—Sense-organ from an antennal segment.
C.—Claws of left hind leg, anterior view.
D.—Claws of right front leg, posterior view.
E.—Cercus.
Lettering as in Fig. 1.

Hanseniella minor sp. nov.

(Fig. 2, A-E.)

Length.—3-4 mm.

Head.—About as broad as long, measuring in adult about 0·36 mm. in diameter. Clothed with numerous equally spaced setae, the largest lateral setae only a very little shorter than the breadth of the proximal antennal joints. "Central rod" exceptionally short and unforked.

Antennae.—Maximum number of antennal segments counted in any adult 32; minimum 22. Setae on inner side of primary ("central") whorls not longer than those on outer side. On first six segments four setae visible above. The secondary whorl begins on the lower side of the seventh and eighth segments, first appearing dorsally on about the fourteenth joint. A true third whorl, posterior to the second, does not develop; there is, however, a whorl of diminutive setae from the eighth segment onwards, situated anterior to the primary whorl (Fig. 2A). The absence of a true third whorl, and the presence of this anterior whorl of small setae sharply distinguish the antennal segments from those of *H. agilis* (cf. Figs. 1A, 2A). The main setae of the primary whorl about equal in length, and about half the diameter of the basal antennal segments. On each segment from the second onwards, is a small sense-organ similar to that already described for *H. agilis,* except that the central spine is short, scarcely exceeding the others in length (Fig. 2B). Terminal segment of antennae with one large and two small stalked sense-organs, as in *H. agilis.*

Scutes.—The first scute slightly convex on its posterior margin; from the third onwards they are slightly indented. A single pair of enlarged outwardly directed lateral setae on the fourth, seventh, tenth, thirteenth and fourteenth scutes. The enlarged seta of the second scute nearly twice the breadth of the basal antennal joints.

Legs.—On the last leg the tarsus is nearly five times longer than thick. "Metatarsus" and tarsus each with five setae in the outer row. On the "metatarsus" the most distal is the largest, but is less than half the thickness of the "metatarsus." The anterior claw (Fig. 2C) of the last leg slightly curved, and forming at its base a broad blade, which tapers less sharply than in *H. agilis.* Posterior claw very curved. It measures two-thirds length of the other. "Front seta" not exceptionally large, being a little shorter than the posterior claw. Its basal half broad and blade-like, its distal half tapering into a thin filament.

On the first leg the anterior claw (Fig. 2D) is only slightly less curved than on the last leg, and the basal blade-like portion is less pronounced. Posterior claw gently curved and a little less than half the length of the anterior claw. Basal portion not as sharply demarcated as in *H. agilis.* "Front seta" robust and a little longer than the posterior claw.

Cerci.—(Fig. 2E). Length from three to four times their thickness; sparsely clad with relatively large setae, of which there are not more than five in a row. They increase in length towards the apex, the largest hinder setae being twice the length of the smallest anterior setae. A single enlarged seta at the apex itself, about equal in length to the thickness of the cercus at its base.

Habitat.—As for *H. agilis.*
Type in National Museum, Melbourne.

Although *H. minor* is about the same size as *Scutigerella indecisa* Attems, there can be no confusion with this form even if it should prove to be a species of *Hanseniella.* Of the described species of *Hanseniella, H. minor* seems to resemble most closely *H. (Scutigerella) subunguiculata* described by Imms from the Himalayas. The resemblance of the antennae in the two species is particularly striking. Points of difference are (i) the first stalked sense-organ in *H. minor* is on the second, not third, antennal segment; (ii) the enlarged seta of the second scute is nearly twice the breadth of the basal antennal segment; (iii) the form of the claw on both anterior and posterior legs is different; (iv) there are about 4-5 large setae in the longitudinal rows along the cerci; Imms' drawings show about 11-12 small setae.

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GRAPTOLITES OF AUSTRALIA: BIBLIOGRAPHY AND HISTORY OF RESEARCH

By R. A. Keble, F.G.S.
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The Australian graptolite fauna is probably the most complete in the world, certainly in regard to its Ordovician components, a fact clearly appreciated by McCoy. He had ready for the press descriptions and figures of most of the species afterwards described in James Hall's Monograph published in 1865, which may be regarded as the basis of systematic graptolite research, when he received from Hall a proof of his figures. McCoy immediately conceded him priority and adopted his specific names. Had Hall delayed sending his proof, McCoy would certainly have published his figures and descriptions and his name would have been just as prominent in the literature of graptolites as Hall's. Commenting on "Graptolites (Didymograpsus) fruticosus (Hall sp.)," McCoy says, "this is the first Victorian graptolite I ever saw, and, as it was then a new species, I had named it in my MSS. after Mr. J. A. Panton, who found it in the soft shales of Bendigo, of which goldfield he was then Warden, and in whose hospitable camp I was then able to recognize the true geological age of the gold-bearing slates of the colony for the first time. The same species was subsequently discovered by Professor Hall in Canada; and as he kindly sent me an early proof of his illustration before publication, I of course adopted his name as above" (Prod. Pal. Vict. I, p. 13, 1874. Melb.). Thus, that well-known species *Tetragraptus fruticosus* J. Hall escaped the specific name *pantoni* McCoy only by months.

The present generation of research workers can scarcely realize the difficulties that confronted the indefatigable pioneers in Australian graptolite research. True, the geologists of the Geological Survey of Victoria collected most of McCoy's specimens, but not all. We find McCoy himself at Bendigo and at other places. Australia was then largely an unsettled country with its ways of communication yet

unopened and the mode of travel either by foot or horse. Bendigo, to refer to it again, may now be reached in a few hours by train or car, but in McCoy's time the journey took three or four days of fatiguing travel. So, too, in T. S. Hall's day, when, although railways made access easier, the difficulties were still formidable. Workers like W. J. Harris and R. A. Keble who have carried on research both before and since the advent of the motor car, can appreciate the difficulties experienced by earlier workers and the enormous advantage modern workers have.

Much of this early work on Australian graptolites has been overlooked, possibly because the literature is difficult of access, and the laborious search for new facts by the pioneers forgotten, for there are few left to tell. It was known to Nicholson, Salter, Lapworth, and other overseas workers, and lest it goes into the limbo of forgotten things, we have taken some trouble to record it.

Abbreviations.

Ann. Mag. Nat. Hist.—The Annals and Magazine of Natural History. London.

Ann. Rep. Dep. Mines, N.S.W.—Annual Report of the Department of Mines of New South Wales. Sydney.

Arkiv f. Zool.—Arkiv för Zoologi utgivet av K. Svenska Vetenskapsakademien. Stockholm.

Aust. Ass. Adv. Sci.—Report of the —— Meeting of the Australasian Association for the Advancement of Science. (New title, Australian and New Zealand Association for the Advancement of Science.) Published in city where meeting is held.

Bul. Geol. Soc. Am.—Bulletin of the Geological Society of America. New York.

Bul. Geol. Surv. Vict.—Bulletin of the Geological Survey of Victoria. Melbourne.

Bul. N.Y. State Mus.—Bulletin of the New York State Museum. Albany.

Fed. Hbk. Brit. Ass. Adv. Sci.—Federal Handbook of the British Association for the Advancement of Science, Melbourne Meeting, 1914. Melbourne.

Geol. Mag.—The Geological Magazine, London.

Geol. Surv. Vict., Map, Q.S.—Geological Survey of Victoria, Geological Map, Quarter Sheet No.—. Melbourne.

Journ. Roy. Soc. N.S.W.—Journal of the Royal Society of New South Wales. Sydney.

Mem. Geol. Soc. Am.—Memoirs of the Geological Society of America. New York.

Mem. Geol. Surv. Vict.—Memoirs of the Geological Survey of Victoria. Melbourne.

Mem. Nat. Mus. Melb.—Memoir of the National Museum. Melbourne.

Mem. N.Y. State Mus.—Memoir of the New York State Museum. Albany.

Min. and Geol. Journ.—Mining and Geological Journal, Department of Mines. Melbourne.

Mon. Pal. Soc.—Monograph of the Palaeontographical Society. London.

Mon. Prog. Rep. Geol. Surv. Vict.—Monthly Progress Report of the Geological Survey of Victoria. Melbourne.
Norsk Geol. Tids.—Norsk Geologisk Tidskrift. Oslo.
Pap. Proc. Roy. Soc. Tas.—Papers and Proceedings of the Royal Society of Tasmania. Hobart.
Phil. Trans. Roy. Soc. London.—Philosophical Transactions of the Royal Society. London.
Proc. Linn. Soc. N.S.W.—Proceedings of the Linnean Society of New South Wales. Sydney.
Proc. Roy. Soc. Vict.—Proceedings of the Royal Society of Victoria. Melbourne.
Prod. Pal. Vict.—Prodromus of the Palaeontology of Victoria. Melbourne.
Prog. Rep. Geol. Surv. Vict.—Progress Report, Geological Survey of Victoria. Melbourne.
Q.J.G.S.—Quarterly Journal of the Geological Society. London.
Rec. Geol. Surv. N.S.W.—Records of the Geological Survey of New South Wales. Sydney.
Rec. Geol. Surv. Vict.—Records of the Geological Survey of Victoria. Melbourne.
Rep. Brit. Ass. Adv. Sci.—Report of the British Association for the Advancement of Science. London.
Summ. Prog. Geol. Surv. G. Brit.—Summary of Progress, Geological Survey of Great Britain. London.
Sver. Geol. Und. Arsbok.—Sveriges Geologiska Undersökning. Arsbok. Stockholm.
Trans. N.Z. Inst.—Transactions and Proceedings of the New Zealand Institute. Wellington.
Trans. Roy. Soc. N.Z.—Transactions and Proceedings of the Royal Society of New Zealand. Wellington.
Vict. Nat.—The Victorian Naturalist. Melbourne.

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History of Research.

First Period: 1856-1892.

In the following pages, numbers enclosed in brackets refer to works listed in the Bibliography. Only those papers that have contributed in some way to our knowledge of Australian graptolites are reviewed in this History of Research.

1856-1865.—The first Australian graptolites were collected by C. D. H. Aplin, N. Taylor, G. F. H. Ulrich, R. Daintree, C. S. Wilkinson, and R. A. F. Murray, Field Geologists of the Geological Survey of Victoria. The identification of these, which appear on their Quarter Sheets (1, 2, 3, 4, 5, 7, and 10), were made by Frederick McCoy, who was appointed Palaeontologist to the Geological Survey in 1856.

1861.—In an essay "On the Ancient and Recent Natural History of Victoria," McCoy (6) summarized his identifications made for the field geologists. He recorded from Victoria *Diplograpsus pristis, D. mucronatus, D. rectangularis, D. ramosus, D. folium, D. bicornis, D. ovatus, Phyllo-*

graptus typus, Didymograpsus serratulus, D. caduceus, D. furcatus, Graptolites gracilis, G. logani, G. quadribrachiatus, G. octobrachiatus, G. ludensis, G. tenuis, G. latus and *G. sagittarius,* forms common to both Europe and America.

1862.—McCoy (8) published the foregoing list in the *Annals and Magazine of Natural History* in anticipation of the specimens being exhibited at the Intercolonial Exhibition to be held in London the following year.

1863.—Salter (9) referred to "a remarkable coincidence even to minutae" in the graptolites from Victoria displayed by McCoy at the Intercolonial Exhibition with those of the Skiddaw Slates, remarking that "they agreed genus for genus, and almost specifically, with the North-of-England forms." He inferred that "there is a peculiar zone or horizon of the Llandeilo rocks of which these genera of graptolites are characteristic." In his list of graptolites from the Skiddaw Slates, he referred to a form as "*Didymograptus* sp. like *G. pantoni* McCoy." He concluded by naming this form *D. v-fractus* and it is specifically distinct from *D. pantoni* (cf. 14).

1867.—McCoy (11) stated that "all the slates containing gold-bearing veins in Victoria were identical in age and character with those in North Wales in which the Romans worked the gold-mines of Gogofau." The majority of the graptolites found in Victoria are found in the Welsh Llandeilo Flags, the Cumberland and the Scotch Shales, and almost all those identified by J. Hall from Canada occur in Victoria. He added *Diplograpsus palmeus* (Barrande), *D. bryonoides* and *D. nitidus* to the list of Victorian forms and stated that "on the upper end of many specimens of *D. palmeus* there is a large, smooth, pear-shaped or heart-shaped appendage which he believed to be an ovarian vesicle."

1872.—Nicholson (12) referred to Australia "in which some of the peculiar genera of the Skiddaw and Quebec groups have been discovered. Here we are compelled to assume that we have a case of migration, though we have at present no data whereby to decide whether the course of migration was from Canada to Australia (as is most probable), or vice versa."

1874.—Etheridge (13) either figured or recorded eleven species from Victoria, nine of which McCoy had previously recorded and two that McCoy had exhibited at the Intercolonial Exhibition as *Didymograptus (?) fruticosus* J. Hall and *D. pantoni* (?) MSS. McCoy (14) described and figured ten species, viz.: *Phyllograptus folium* (His.) var. *typus*

(Hall), *Diplograpsus mucronatus* (J. Hall sp.), *D. pristis* (His. sp.), *D. rectangularis* (McCoy), *D. (Climacograptus) bicornis* (J. Hall), *Graptolites (Didymograptus) fruticosus* (J. Hall sp.), *G. (D.) bryonoides* (J. Hall sp.), *G. (D.) octobrachiatus* (J. Hall sp.), and *G. (D.) logani* (J. Hall) var. *australis* nov.

J. Hall described and figured *Tetragraptus fruticosus* in 1857. McCoy states (loc. cit.) that he had previously named it in manuscript *"pantoni,"* but as Hall had forwarded proofs of a manuscript in which the specific name *"fruticosus"* was used, he adopted it. Both Hall and McCoy describe and figure the three-branched and four-branched forms, but not the two-branched form. Etheridge (13) figures the two-branched under the name of *Didymograptus pantoni* (?) which, being both generically and taxonomically in order, must receive priority.

1875.—Hopkinson and Lapworth (15) drew attention to the fact that species characteristic of the Middle Arenig of St. David's, Wales, occur in Australia.

McCoy (16) figured and described seven species, viz.: *Graptolites (Didymograpsus) extensus* (J. Hall), *G. (D.) caduceus* (Salter), *Diplograpsus palmeus* (Barr. sp.), *Cladograpsus ramosus* (J. Hall sp.), *C. furcatus* (J. Hall sp.), *Graptolites (Didymograpsus) gracilis* (J. Hall), *Retiolites australis* sp. nov.

1876.—McCoy (17) described and figured *Didymograpsus thureaui.* He suggested the genus *"Goniograptus"* for such forms in which the "branches of the funicle (for which he introduced the name stolons) are angularly bent at the points of budding into celluliferous stems." He thus distinguished between monopodial and dichotomous branching.

1877.—McCoy (18) again described and figured *Graptolites (Didymograpsus) thureaui* (cf. 17), also *G. (D.) headi* (Hall).

1879.—Etheridge (19), in his catalogue of Australian fossils, included all the Victorian graptolites hitherto identified by McCoy except *Goniograptus thureaui* and systematized the somewhat confused taxonomy.

1885, 1886.—Herrmann (20, 21) commented on the cosmopolitan distribution of the graptolites, pointing out that they are found in three continents, viz. Europe, America, and Australia. He referred to the researches of McCoy and Etheridge as showing their affinities with the British Arenig and Llandeilo.

1887.—R. A. F. Murray (22) listed the identifications hitherto made by McCoy. He also recorded from Deddick* *Diplograpsus rectangularis* McCoy, and from Guttamurrh Creek, Snowy River, *Didymograpsus caduceus* and *Diplograpsus foliaccus* "in vertical slates capping the granite."

The First Period of Research might aptly be called McCoy's Period, for on his identifications was based all that was adduced in connection with Australian graptolites. The fauna was correlated with the European and American which, at that time, was still imperfectly known. No attempt was made to discover an Australian stratigraphical sequence.

Second Period: 1892-1932.

Early in the Second Period, T. S. Hall (25) suggested a basis for zoning the Australian fauna and subsequently developed it (28 and 64). W. J. Harris and R. A. Keble (81, 121) working on Hall's zones, defined them and showed that they were capable of much closer subdivision.

1892.—G. B. Pritchard (23) described and figured *Temnograptus magnificus* sp. nov. from Lancefield (cf. 39). T. S. Hall (24) described and figured *Dictyonema grande* sp. nov. (cf. 31).

1893.—T. S. Hall (25) suggested a basis for zoning the Victorian Lower Ordovician and named some of the zonal graptolites that could be used, among which were *Tetragraptus fruticosus, Didymograptus caduceus, D. bifidus, Phyllograptus typus* and *Loganograptus logani.*

1895.—G. B. Pritchard (27) added to his description (23) of *Temnograptus magnificus* and T. S. Hall's species *Dictyonema grande* (24). He compared Victorian forms of *Clonograptus flexilis* with J. Hall's original description. He also recorded *Tetragraptus quadribrachiatus* from Lancefield.

T. S. Hall (28) instituted a system of zoning for the Castlemaine area which was incidentally to become the basis for the Lower Ordovician of Victoria. The Castlemaine area is suited to such a purpose as the railway cuttings and water races are generally at right angles to the strike and sections are exposed over long distances. He referred to *Didymograptus caduceus* as *Tetragraptus caduceus,* an anomaly that he says (cf. 29) was forced on him by the confused synonymy of *Didymograptus caduceus.* He also listed the hitherto unrecorded *Thamnograptus* sp. and *Dichograptus kjerulfi.* He commented on the similarity of some forms of *Tetra-*

*If a locality is in any other State than Victoria, the particular State is always mentioned.

graptus fruticosus to *D. v-fractus* (9). All other species mentioned by T. S. Hall were previously recorded by McCoy.

After commenting on the associations at Bendigo, Daylesford, Lancefield, Gisborne, Darriwil and New Zealand, he proposed the following zoning, the beds being arranged in descending order:

1. Zone of *Loganograptus logani* occurring at Castlemaine and Darriwil.
2. Zone of *Tetragraptus caduceus* occurring at Castlemaine.
3. *Phyllograpto-caduceus* zone occurring at Castlemaine.
4. Burns' Reef Beds occurring at Castlemaine.
5. Wattle Gully Beds occurring at Castlemaine and (?) in New Zealand.
6. Zone of *Tetragraptus fruticosus* occurring at Chewton, Bendigo, Spring Plains, Tarilta, Upper Loddon, Daylesford, Gisborne and to the north-west of Lancefield.
7. The Lancefield shales.

Hall called No. 1 the Darriwil Zone. It rests immediately above 2, 3, 4, and 5, which together form the Castlemaine Zone; and this, in turn, rests on the Bendigo Zone, which Hall defined as the strata containing *Tetragraptus fruticosus*. All strata below the Bendigo Zone containing graptolites were called by Hall the Lancefield Zone. He was more or less hazy as to what constituted his Darriwil and Lancefield Zones.

1896.—T. S. Hall (29) commented on the synonymy of Salter's *Didymograptus caduceus*, described from a Canadian specimen, and regarded Salter's species as valid. He pointed out that Nicholson (after following J. Hall, who made Salter's *D. caduceus* synonymous with *Tetragraptus bigsbyii)* "found a species in the Skiddaw Slates which seemed to agree perfectly with Salter's Canadian species. This species he named *Didymograptus gibberulus*" stating that "Salter's original specimen," (although he had not seen it) "was beyond doubt an example of *Tetragraptus bryonoides* or *T. bigsbyi*, and that Salter had confused an English species with it." T. S. Hall pointed out the improbability of this and contended that "*D. gibberulus* must be relegated to synonymy, for it does not seem separable from *D. caduceus*."

1897.—T. S. Hall (30) recorded from Wombat Creek, North-eastern Victoria, *Climacograptus bicornis* and *Dicellograptus elegans;* from Tungamah, (?) *Dicellograptus sextans,* (?) *Dicranograptus ramosus* and *Diplograptus pristis;* from Walwa (Walwal) Creek, *Dicellograptus*

anceps, Diplograptus pristis, D. truncatus, Climacograptus bicornis; and from an area east of the Snowy River, *Diplograptus rectangularis, D. foliaceus* and *Didymograptus caduceus.*

T. S. Hall (31) recorded from a locality four miles from Matlock, Victoria, on the Wood's Point Road, forms comparable with *Dicellograptus morrisi* and *Diplograptus foliaceus.*

He pointed out that the specific name *"grande"* (24) in *Dictyonema grande* was preoccupied and he substituted *"macgillvrayi"* for it. He discussed the relative position of the graptolite bed at Lancefield in regard to other beds in Victoria.

He examined (32) a collection of graptolites from Coimadai. From Basin Creek he identified *Didymograptus bifidus, D. murchisoni, D. extensus, Tetragraptus quadribrachiatus, T. serra, Phyllograptus typus, P. angustifolius;* from Cockatoo Gully, *Didymograptus extensus, D. caduceus, Tetragraptus* cf. *quadribrachiatus, Phyllograptus* (?) *angustifolius;* from Back Creek, *Didymograptus caduceus;* from Deep Creek, Melton, *D. caduceus, Tetragraptus serra, Dichograptus* (?) sp. nov., *Phyllograptus typus* (?), *Diplograptus* sp. (very common).

W. S. Dun (34) recorded graptolites from the County of Wellesley, New South Wales. From the Parish of Lawson, he identified *Dicranograptus furcatus, Didymograptus* cf. *caduceus, Diplograptus* cf. *mucronatus, D.* cf. *rectangularis* and *Phyllograptus* (?); from the south-west corner of the Parish of Currawang, *Diplograptus* cf. *palmeus, Dicranograptus* sp., *Dicellograptus* sp.; from Stockyard Creek, Parish of Alexander, *Dicranograptus furcatus, Diplograptus* cf. *palmeus, D.* cf. (? *rectangularis* McCoy), *Dicellograptus* sp.; from 1½ miles south of Portion 2, Parish of Tingaringi, *Diplograptus* cf. *palmeus, Didymograptus* sp., *Dicranograptus furcatus, Dicellograptus* sp.

1898.—W. S. Dun (35) identified *Diplograptus, Climacograptus* and *Dicellograptus* from Myall Reef, near Tomingley, in the Peak Hill District, New South Wales.

T. S. Hall (36), after reviewing the evidence, thought that a graptolite, probably referable to *Diplograptus,* may have been found at Lisle, Tasmania.

1899.—T. S. Hall (37) compiled a list of identifications from various localities in Victoria. The localities are at Wombat Creek, Chewton, Cabanandra, Bulla, Sunbury, Deddick, Bendigo, Sandy's Creek, Ryan's Creek, Tarilta,

Newham, Parwan, Darriwil, Holden, Leigh River, Melbourne, Lancefield, Loddon River, Kangaroo Creek, Coolbarghurk, Spring Plains, Daylesford, Cockatoo Gully, Werribee Gorge, Watchbox Ranges, and Redesdale. Most of these localities are from the Quarter Sheets (*vide* 1, 2, 3, 4, 5, 7, 10).

He recorded from Alexandra, *Monograptus* cf. *galaensis;* from McLauchlan's Creek, south of the Victorian border, East Gippsland, (?) *Dicellograptus morrisi, D. anceps, Diplograptus truncatus,* (?) *Climacograptus caudatus;* and from Thoona, *Glossograptus, Diplograptus, Climacograptus* and cf. Dichograptidae. From the Moorabool River near Maude, he recorded *Tetragraptus* cf. *quadribrachiatus.*

He recorded (38) from Cravensville, *Climacograptus bicornis* et var. *tridendatus, Diplograptus foliaceus, Dicellograptus sextans, Glossograptus* sp.; from mid-way between Cravensville and Dart River, *Didymograptus* sp.; from Glendart, near Dart River, *Climacograptus* sp., *Glossograptus* sp., *Diplograptus* sp. He gives the age of the Cravensville beds as Upper Ordovician.

He adds that the *Glossograptus* obtained from Cravensville and Glendart is identical with that previously recorded from Sandy's Creek (37), and Tungamah (30).

A collection of graptolites from a small quarry a few hundred yards north of the disused Mt. William Railway Station near Lancefield disclosed a number of new species as well as already described forms on which he had based his Lancefield Zone. The new species described and figured (39) were *Bryograptus victoriae, B. clarki, Leptograptus antiquus, Didymograptus pritchardi, D. taylori, Tetragraptus decipiens, Dictyonema pulchellum,* and he recorded *Clonograptus flexilis, C. magnificus, C. rigidus, C. tenellus, Phyllograptus* sp. and *Dictyonema macgillvrayi.*

He reviewed (40) the earlier graptolite work done by McCoy and others. He pointed out that the work of these pioneers, as in England before Lapworth undertook his work of revision, is unreliable. He stressed the fact "that the minute differences on which it has been found advisable to separate the species in this difficult group were not then generally recognized, and we find many of our graptolites identified with forms from which we now regard them as even, it may be, generically distinct. In the case of those forms where the method of branching and the habit is a guide there was, of course, less liability to confusion, and here the specific identifications are of value, but it is extremely doubtful, on the other hand, whether any of the

Diplograptidae have been correctly determined and a great number of those forms referred to *Didymograptus* (*sensu stricto*) are probably incorrectly identified. One feature, however, must not be overlooked, and this is that the records have in many cases been made from exact localities; and this in the case of Sir F. McCoy's papers, owing to his official connection with the Survey, is of peculiar value, as the precise position from which the fossils came is recorded both by him and on the Geological maps, and we are thus frequently able to check the records in a very effective way."

Discussing the sequence, he commented on certain species that seem anomalous in other countries. The form he named *Leptograptus antiquus* (39, cf. 111), though not perhaps a typical member of the genus, is certainly not a *Didymograptus*. It has since been made synonymous with *Bryograptus* (111). *Didymograptus bifidus* (now *D. protobifidus* (151)) dies out long before *Phyllograptus typus* has disappeared and is survived by a *Clonograptus* and two or three species of *Dichograptus*. He emphasized the fact that in the Northern Hemisphere *Clonograptus flexilis* is associated with forms which characterize the next higher horizon in Victoria. The case of *C. rigidus* is also striking, for though in America it is, according to Amii, associated with *Loganograptus,* yet with us the latter genus does not appear till *Phyllograptus typus* and closely allied species have become extinct. In regard to this statement of Hall's it should be stated that *Loganograptus* has since been found at a much lower horizon (131).

Hall discussed the composite fauna of the Lower Ordovician in regard to the Lancefield, Bendigo, Castlemaine and Darriwil Series. Apart from the Castlemaine Series he does not mention limiting forms. He states that the Darriwil Fauna "differs from the typical Castlemaine fauna by the almost entire absence of *Didymograptus caduceus* and the appearance of *Lasiograptus* and *Glossograptus*. *Trigonograptus* and several species of *Didymograptus* and *Climacograptus* occur, while *Tetragraptus serra* and *Loganograptus* still persist. This series appears to mark the close of the Lower Ordovician as in the succeeding rocks Dicranograptidae put in their appearance." Thus he regarded the appearance of *Dicranograptus* as heralding the incoming of the Upper Ordovician.

He commented on Upper Ordovician species, pointing out that no stratigraphical work had yet been done.

In regard to the Silurian, he identified *Monograptus*

priodon from Macclesfield and *M.* cf. *dubius* from South Yarra; he also mentioned other occurrences. He thought the record of *Phyllograptus* (34) in New South Wales is doubtful.

He described and figured *Tetragraptus projectus* sp. nov. and *Trigonograptus wilkinsoni* sp. nov. He also commented on and figured *Didymograptus gracilis* Torn., *Leptograptus antiquus* T. S. Hall (now *Bryograptus antiquus), Dichograptus octonarius, Clonograptus tenellus* and *Bryograptus victoriae.*

1900.—W. S. Dun (41) recorded from the Coolgardie Gold Mine G.L. 14, Parish of Clarendon, County of Bathurst, New South Wales, at a depth of 150 feet, a number of specimens of *Diplograptus.*. He could not say whether they were Ordovician or Silurian.

T. S. Hall (42) described and figured a number of graptolites from Mandurama, New South Wales, including *Climacograptus affinis* sp. nov. and *Diplograptus manduramae* sp. nov. The graptolites were associated with radiolaria and *Agnostus.*

1902.—T. S. Hall (43) considered that the evidence of transgression in the case of graptolites is somewhat stronger (than in other groups), and is more clearly seen, as the collecting in part of our (Victorian) Lower Ordovician has been done zonally. "I have elsewhere (39) shown," he continues, "that on the same slabs of rock at Lancefield we find *Bryograptus* and *Clonograptus tenellus,* which in Europe are exclusively Cambrian, associated with *Didymograptus, Tetragraptus, Clonograptus flexilis, C. ridigus, Phyllograptus,* and two species of *Dictyonema* which are just as typically Lower Ordovician in Europe. In America *Clonograptus flexilis* is associated with such forms as occur at Bendigo, the next horizon above the Lancefield beds, which do not contain them, while *C. rigidus* is found with *Loganograptus logani.* Now, in Australia, the last named does not put in an appearance till the rich fauna of Bendigo and a great part of the Castlemaine series, which is younger than the Bendigo series, has disappeared entirely (cf. 131). Another example may be quoted. The group characterized by *Didymograptus bifidus* (cf. 151) 'the tuning-fork graptolites,' as they are sometimes called, is in Europe and America characteristic of the Upper Arenig, when the complexly branched forms, and the peculiar *Phyllograptus,* have died out. With us their horizon is lower and their range very short. *Phyllograptus, Clonograptus,* and *Dichograptus* long

survive them, while *Loganograptus logani* only puts in an appearance when they, in their turn, have almost passed away. Graptolites are not always easy of recognition, but these forms all belong to readily-recognizable groups; the specific determinations, it is possible, may be incorrect, but the generic cannot be confounded."

He recorded and figured (45) from Belle Vale, Yass, New South Wales, a *Monograptus* which he ascribed to the *M. dubius* group.

He described and figured (46) from Sandy's Creek, Mitchell River, *Didymograptus ovatus* sp. nov. and *Glossograptus hermani* sp. nov.

He tabulated the species already recorded from Upper Ordovician localities.

He recorded from Castlemaine, *Goniograptus macer, Didymograptus* aff. *nitidus* and *D. extensus.* From a locality 1½ miles south-west of Kelly's Hill, Matlock, he recorded *Dicellograptus morrisi, Diplograptus foliaceus* and other forms and assigns the beds to the Upper Ordovician.

He examined (47) the graptolites in the collection of the Geological Survey of New South Wales. From Stockyard Creek, he identified *Dicellograptus affinis, D.* cf. *divaricatus, Diplograptus carnei, D. foliaceus, Climacograptus bicornis, C. hastata, C. tubuliferus, Cryptograptus tricornis* (vide 63), and *Retiolites caudatus;* from Currawang, (?) *Dicellograptus affinis, Dicranograptus zic-zac* var. *minimus, Diplograptus foliaceus, Climacograptus bicornis* and *C. tubuliferus* (?); from Lawson, *Dicranograptus zic-zac* var. *minimus, Glossograptus* cf. *mucronatus* and *Clathrograptus* cf. *geinitzianus;* from Orange, *Diplograptus carnei;* from Tomingley, *Dicellograptus* cf. *divaricatus, Diplograptus carnei, D. foliaceus, D.* cf. *whitfieldi, Climacograptus tubuliferus, Callograptus* cf. *salteri, Dictyonema* sp. and *Dendrograptus* spp.

He described and figured *Dicellograptus affinis* sp. nov., *Diplograptus carnei* sp. nov., *Climacograptus hastata* sp. nov. and *Retiolites caudatus* sp. nov. "Certain species identified from Victorian rocks by the late Sir F. McCoy," he said, "namely, *Diplograptus mucronatus* J. Hall, *D. rectangularis* McCoy and *D. palmeus* Barr. are not those species, the two latter, indeed, not occurring in Ordovician rocks at all, but being characteristic of Silurian age."

He discussed (48) the evidence for the existence of graptolites at a locality near the Ring River, north-east of Dundas Railway, and from near Zeehan, both in Tasmania.

1904.—T. S. Hall (51) recorded from slate pebbles at San

Remo the genera *Diplograptus, Climacograptus, Dicellograptus, Dictyonema, Callograptus* and *Ptilograptus.* He figured *Callograptus* and *Ptilograptus.*

From Knowsley East he recorded a form resembling *Ptilograptus;* from near the "trap" area marked on Q.S. 15 NE., near Vaughan, *Didymograptus bifidus, D. extensus* (?), *Tetragraptus quadribrachiatus, T. serra, T. fruticosus* (3-branched variety), *Phyllograptus typus;* from Wood's Point District, *Dicellograptus affinis, Diplograptus foliaceus, D.* cf. *tamariscus, Climacograptus hastatus, C. tubuliferus, C.* cf. *innotatus;* from Bald Hill, Waratah North, *Diplograptus* sp.; and from boulders at Grice's Creek, Mornington, *Climacograptus* and *Diplograptus.*

From Balnarring, he recorded *Tetragraptus approximatus, T. quadribrachiatus, T. fruticosus* and *Didymograptus* cf. *pritchardi.* This is the first record of *Tetragraptus approximatus* in Australia. From Bulldog Creek, near Dromana, he recorded *T. approximatus, T. quadribrachiatus, T. fruticosus;* from the junction of Stander's Creek with the Goulburn River, near Wood's Point, he recorded a form belonging to *Dendrograptus* or *Dictyonema.*

1905.—T. S. Hall (52) recorded from near Mt. Wellington, *Diplograptus thielei* sp. nov., *Climacograptus wellingtonensis* sp. nov., *C. bicornis, Cryptograptus tricornis, Lasiograptus* sp., *Dicellograptus elegans, Dicranograptus nicholsoni,* and *D. hians* sp. nov. He described and figured *Diplograptus thielei, Climacograptus wellingtonensis* and *Dicranograptus hians.*

1906.—T. S. Hall (53) recorded from Turquoise Mine, Ryan's Creek, Myrhee, *Diplograptus* sp.; from Mt. Avis, Edi, *Diplograptus, Climacograptus, Glossograptus* and a doubtful *Didymograptus.* He regarded the beds as Upper Ordovician.

From Graptolite Gully, Jordan River, Aberfeldy District, on the track half-a-mile from the Thomson River junction, he recorded *Monograptus dubius* which he described and figured. From the northern slope of Mt. Easton he recorded *Dicellograptus affinis, D. elegans, Climacograptus tubuliferus, C. bicornis, Glossograptus fergusoni;* from Dingo Creek, *Dicellograptus affinis, D.* cf. *forchammeri* and *Diplograptus foliaceus;* a mile south from the Thomson-Jordan junction, *Monograptus* cf. *dubius;* from the Cornish Line of Reef, Daylesford, *Didymograptus bifidus, Tetragraptus quadribrachiatus, T. fruticosus, T. bryonoides* and *Phyllograptus typus;* from the Little Snake Reef, Trentham, *Tetragraptus quadribrachiatus;* from The Springs, Daylesford, *T.*

fruticosus, T. bryonoides, and *Phyllograptus typus;* from Bullarto, *Didymograptus caduceus;* from Bullarto railway-cutting, *Phyllograptus angustifolius;* from the spur between Boy's and Bell's Creek, on the track along the Thomson River, 4½ miles below the Jordan junction, *Monograptus* sp. and *Pristiograptus;* from the spur south-west of Blaze XIII, at Thomson River, 5½ miles from the Jordan junction, *Monograptus* sp.; from No. 10 spur on the Main Divide, between Spring Hill and Mt. Selma, *Diplograptus* sp.; from Black River, near junction of Ten Mile Creek, *Dicranograptus* sp., *Diplograptus* cf. *murchisoni;* from Bendigo, Concord Company's Lease, *Tetragraptus serra, T. fruticosus* (3 and 4-branched), *Phyllograptus typus,* from between Lansell's 180 Mine and Victoria Reef Mine, *Tetragraptus fruticosus* (3 and 4-branched), *T. pendens, Dichograptus octobrachiatus;* from Hustler's Line of Reef, *Tetragraptus fruticosus* (3 and 4-branched), *T. approximatus, T. quadribrachiatus, T. bryonoides, T. serra,* and *Dichograptus octobrachiatus;* from two miles north-west of Mt. Easton, *Leptograptus flaccidus, Dicellograptus complanatus* var. *ornatus, Diplograptus carnei, Climacograptus mensoris* sp. nov., and *Retiolites caudatus;* from three-quarters of a mile north-west of Mt. Easton, *Leptograptus flaccidus, Dicellograptus elegans, Dicranograptus ramosus* var. *semispinifer* nov., *D. hians, D. nicholsoni, Diplograptus ingens* sp. nov. *D. foliaceus, D.* cf. *aculeatus, D. quadrimucronatus, Cryptograptus tricornis, Climacograptus baragwanathi* sp. nov. and *C. bicornis.* He described and figured *Climacograptus mensoris, Leptograptus flaccidus, Dicellograptus elegans, Dicranograptus ramosus* var. *semispinifer, Diplograptus ingens, D. quadrimucronatus,* and *Climacograptus baragwanathi.* He figured *Dicellograptus complanatus* var. *ornatus, Diplograptus carnei* and *Retiolites* sp. He also commented on *Diplograptus foliaceus, D.* cf. *aculeatus, Cryptograptus tricornis* and *Climacograptus bicornis.*

1907.—T. S. Hall (56) recorded from the Painswick Railway Station ground, near Dunolly, (?) *Bryograptus* or *Dendrograptus,* (?) *Clonograptus* and (?) *Tetragraptus decipiens;* from Q.S. 22 NW., north-west of Mt. Easton, *Dicranograptus ramosus* var. *semispinifer, Diplograptus ingens*; from the railway quarry near the four and a half mile post, railway viaduct, Ingliston, *Tetragraptus serra, Phyllograptus* sp. and *Didymograptus caduceus;* from Ingliston, 42¾ miles, in railway cutting, *D. caduceus;* from a site 100 chains distant on a bearing E. 35° 53′ from the middle

of the Painswick Railway Station ground, near Dunolly, *Tetragraptus decipiens,* (?) *Clonograptus magnificus, C.* cf. *tenellus, C.* sp. and *Bryograptus* sp.; from Dunolly (No. 32 on Locality Map) *Tetragraptus decipiens, Clonograptus tenellus* and *C.* sp.; from a site 242 chains south from the SE. corner of Allotment A18, Parish of Moliagul, near Dunolly, *Tetragraptus decipiens, Didymograptus pritchardi, Clonograptus magnificus, C. tenellus* and *Dictyonema macgillvrayi;* from the Daylesford Mine Mullock Tip, *Tetragraptus fruticosus, T. bryonoides, T. serra, Didymograptus bifidus* and *Phyllograptus typus;* from the Daylesford Shaft, quarter-mile south of the New Cornish Company's Shaft, *Didymograptus* cf. *extensus* and *D. caduceus;* from Daylesford, north side of Jubilee Lake, quarter-mile east of railway station, *Didymograptus caduceus* and *Dichograptus octobrachiatus;* from near Dartsmouth, four chains from battery in gully, Green's Creek, *Diplograptus* cf. *foliaceus;* from Bald Hill quarry, Parish of Kangerong, east of Dromana, *Didymograptus* sp., *D.* cf. *extensus, Tetragraptus pendens, T.* cf. *quadribrachiatus,* and *Clonograptus* sp.; from south-east portion of Jamieson's Special Survey, Parish of Kangerong, *Tetragraptus approximatus, T. fruticosus* and *Clonograptus* sp.

He identified (57) from several specified localities in the Dunolly district, *Clonograptus tenellus, C. rigidus, C. magnificus, Tetragraptus decipiens, Didymograptus pritchardi;* from the Jordan River, *Diplograptus calcaratus, D. tardus* sp. nov., *Climacograptus bicornis* et var. *peltifer, Cryptograptus tricornis, Glossograptus* cf. *hermani, Dicellograptus elegans, D. sextans, Dicranograptus furcatus, D. ramosus* et var. *longicaulis, D. nicholsoni;* from the Little Jordan Creek, *Diplograptus tardus* and *Dicranograptus nicholsoni.*

From certain specified localities on the Thomson River, Q.S. 22 NW., he recorded *Monograptus* cf. *dubius, M. crenulatus,* and *M.* sp. (colonus group); from Kangerong, *Tetragraptus approximatus, T. fruticosus, T. quadribrachiatus, Clonograptus magnificus;* and from specified localities at Bendigo, *Tetragraptus quadribrachiatus, D. latus* sp. nov., *Tetragraptus fruticosus, T. serra, T. approximatus, Dichograptus octobrachiatus, Goniograptus thureaui, Clonograptus flexilis* and *Phyllograptus typus.* From Myrtleford he examined some fragmentary forms that he considered to be possibly a *Bryograptus* allied to *B. victoriae.*

He described and figured *Diplograptus tardus* and *Didymograptus latus.* He commented on and figured *Diplo-*

graptus calcaratus, Glossograptus cf. *hermani, Dicranograptus ramosus* var. *longicaulis, Dicellograptus sextans* and *Climacograptus bicornis* var. *peltifer.*

E. W. Skeats (58) found at Mooroodue at localities indicated on his map of the area, *Didymograptus caduceus, Tetragraptus serra (sensu stricto), Diplograptus* sp. *Trigonograptus* sp., *Lasiograptus* sp. and *Glossograptus* sp. T. S. Hall, who identified these graptolites, states that "the horizon is that of the Upper Castlemaine series, although the presence of *Glossograptus* is suggestive of the horizon of the Darriwil series. The species of *Diplograptus* is similar to the one which occurs as low down as the Victoria Gully beds at Castlemaine, but is indistinct."

1908.—T. S. Hall (59) reported *Dicellograptus* fragments from Myrtleford; from Kerrie, Riddell, *Climacograptus* sp.; from the Parish of Barp, *Dictyonema* and *Dendrograptus;* from the Parish of Painswick, *Clonograptus magnificus* (?), *C. flexilis, Tetragraptus decipiens, Dichograptus octobrachiatus, Dictyonema* spp. and *Phyllograptus typus* (?); from the railway cutting between Goldsbrough and Bealiba, *Clonograptus* cf. *rigidus;* from Allotment 14A, Parish of Tarnagulla, what appeared to be a Dicellograptid; from the Parish of Wareek, *Clonograptus gracilis, C. magnificus, C. rigidus, C. tenellus, Bryograptus* probably *victoriae, Tetragraptus decipiens* and *Leptograptus antiquus.* This collection is interesting as being the most westerly yet found in Australia. From Bendigo, he identified *Tetragraptus fruticosus, T. bryonoides, T. serra, T. pendens, Goniograptus thureaui, G. macer, Dichograptus octobrachiatus, Didymograptus extensus* and *Phyllograptus typus;* from Daylesford, *Tetragraptus fruticosus, T. pendens, T. quadribrachiatus, Didymograptus bifidus, D. caduceus, D. extensus, D. murchisoni, D. nitidus, Goniograptus macer,* and *Phyllograptus typus;* from Dolly's Creek, three miles north-east of Elaine, *Tetragraptus fruticosus, T. pendens, T. bryonoides, T. serra, T. quadribrachiatus, Didymograptus bifidus, D. nitidus, D. extensus* and *Phyllograptus typus;* from Marong, *Tetragraptus fruticosus, T. bryonoides, T. serra, Phyllograptus typus, Didymograptus nitidus, D. bifidus, Goniograptus macer.*

He corrects his identification of *Retiolites caudatus* from Mt. Easton (53) to *Lasiograptus margaritatus* Lapw.

T. S. Hart (61) collected graptolites at a number of localities at Daylesford. The greater part of the collecting was done between Sailor's Creek on the west, and the line of the Dry Diggings Road on the east, extending north and south over a distance of about six miles. He states that many of

the forms were examined and identified by T. S. Hall. Hart divided the area into three parts, a western area, west of the line of strike passing through the Ajax Mine, which belongs to the Bendigo Series; a central belt, with Bendigo beds on its west side and the Wattle Gully series farther east; and his eastern localities east of the Ballarat railway near Woodburn and eastwards from the Springs at Hepburn, all of which are referable to parts of the Castlemaine Series above the Wattle Gully beds.

From the western area he fixed a number of localities more or less precisely and refers to them by numerals from 1 to 13. From them he recorded *Tetragraptus fruticosus, T. bryonoides, T. pendens, T. quadribrachiatus, Didymograptus bifidus, D.* cf. *murchisoni, Goniograptus thureaui, G. macer* and *Phyllograptus typus.* In the central area, he numbered his localities 14 to 43. He recorded from them *Didymograptus bifidus, D. extensus, D.* cf. *nicholsoni, D. caduccus, Tetragraptus bryonoides, T. serra, T. quadribrachiatus, T. fruticosus, Clonograptus abnormis, C. flexilis* (?), *Phyllograptus typus* and *Dendrograptus* sp. (?). From the eastern localities numbered, 44 to 54, he recorded *Didymograptus caduceus* (large), *D. nitidus, Dichograptus octobrachiatus, Tetragraptus quadribrachiatus, Phyllograptus typus* and *P. angustifolius.*

In regard to these faunas he points out that there is—

1. A series of beds in which *Didymograptus caduccus* is abundant and sometimes large, associated with *Phyllograptus angustifolius* and *Didymograptus nitidus,* neither of which he found in other beds, and *Tetragraptus quadribrachiatus,* which also appears in other beds.
2. A series characterized by the extreme abundance of *Didymograptus bifidus.*
3. Beds with *Phyllograptus typus, Tetragraptus fruticosus,* and *T. bryonoides.*

In these beds *Didymograptus bifidus* is seldom present and never common. *Tetragraptus fruticosus* is never observed in beds in which *D. bifidus* is common.

4. At one locality with *Phyllograptus typus* and *Tetragraptus bryonoides, Clonograptus* was conspicuous, but neither *Tetragraptus fruticosus, Didymograptus bifidus* nor *D. caduccus* was noticed there.

This may be summarized as follows:

3rd, beds with abundant *Didymograptus caduceus,* newer than

2nd, beds with abundant *Didymograptus bifidus* and with *Phyllograptus typus,* newer than

1st beds with *Tetragraptus fruticosus* and *Phyllograptus typus,* the oldest beds observed.

This is in agreement with delimitations at Castlemaine, but Hart said that he had not collected in beds that can be decisively referred to that part of the series in which *Didymograptus caduceus* has begun to be common and *Phyllograptus typus* has not disappeared. On the other hand, there are apparently beds at Daylesford above the horizon at which *Tetragraptus fruticosus* ceases to be common but older than the beds with abundant *Didymograptus bifidus* which may be a local unimportant peculiarity. He tabulated the species records under the numbers of their localities and marked them on a transverse section.

T. W. E. David (62) recorded *Leptograptus* from a locality about two miles westerly from Berriedale, on the Kosciusko Plateau, New South Wales.

1909.—T. S. Hall (63) recorded from Tallong, New South Wales, *Dicellograptus elegans, Dicranograptus nicholsoni, D. hians* var. *apertus, D.* cf. *cyathiformis, Diplograptus, D. foliaceus, Climacograptus bicornis, Cryptograptus tricornis,* and *Glossograptus quadrimucronatus.*

He summarized (64) our knowledge of Victorian graptolites. He stated that *Tetragraptus approximatus* was an important zone fossil, being associated with both the lower part of the Bendigonian and the upper part of the Lancefieldian.

He examined a graptolite from Ballarat and considered it to be a Dichograptid, but otherwise indeterminate.

W. G. Woolnough (65) stated that an abundant and well preserved graptolite-fauna is present in the slates at Marulan and Tallong, New South Wales.

C. F. Laseron (66) exhibited *Diplograptus, Climacograptus* and *Dicellograptus* from a band of black slate in a creek crossing the Adaminaby Road, 11 miles from Cooma, New South Wales. He regarded the strata as a continuation of that of the Berriedale area.

1910.—F. Chapman (67) commented on graptolites from the Yarra Improvement Works, excavations made along the south side of the River Yarra, between Brander's Ferry and the South Yarra Railway Bridge. He stated that they "may be provisionally referred to as two types, which bear certain resemblances in the shape and width of the thecae to *Monograptus concinnus* Lapw. and *M. cyphus* Lapw.

1911.—R. Ruedemann (68) discussed the stratigraphic significance of the wide distribution of the graptolites and stated that "the closer investigation of the graptolites in Europe, America and in Australia has brought out the fact of the presence in all three continents of the common or guide graptolites, of the Ordovicic at least, and of the general agreement of the sequence of zones. The distribution of an important fraction (roughly, at least one-third) is world-wide."

He cited the late appearance of *Loganograptus* in Australia (cf. 40, 131), and the Deep Kill beds of New York as evidence that "if new forms originated in one oceanic basin they so rapidly spread into the others that deposition of rock did not take place sufficiently quick to record this migration in the rock."

He then discussed the American graptolite zones in regard to their connections with the Atlantic and Pacific basins. "The principal Atlantic graptolites," he says, "are fully at home in the Pacific. We find, for instance, one horizon in Victoria, Australia, characterized by *Didymograptus bifidus* (cf. 151), *D. extensus* (?), *Tetragraptus quadribrachiatus, T. serra, T. fruticosus, Dichograptus, Phyllograptus typus* and *P.* sp. and the fact that the differences in the time of appearance of some important forms between Australia and Europe (as the later appearance of *Loganograptus logani* and the earlier appearance of *Didymograptus bifidus* in Australia) are exactly duplicated in our Deep Kill Zones, and the appearance of *Goniograptus thureaui* in both Australia and the Levis Channel are strong arguments not only in favour of some connection of the Levis basin with the Pacific Ocean, but even of the arrival of some of the forms of this far distant basin by a current from the west."

1912.—T. S. Hall (69), from the evidence then before him, fixes the age of the rocks at Marong as Bendigonian, the presence of *Didymograptus nitidus* indicating that they are not the lowest and the absence of "tuning-fork" graptolites, negative evidence of no great value, that the uppermost Bendigonian is not represented. Regarding the age of the rocks about Dunolly, he prefaces his remarks with a discussion of the characteristic fossils of the Bendigonian, viz.: *Tetragraptus fruticosus, T. pendens* and *Goniograptus thureaui. Tetragraptus approximatus* is characteristic of the lowest part of the Bendigo Series and passes into older rocks below "while *T. serra, T. bryonoides* and *Phyllograptus typus* range throughout, but also pass up into the higher series

of beds. Below the Bendigo series is found a series of rocks which are best studied at Lancefield, and are hence called Lancefieldian."

The district to which his subsequent remarks apply extends westwards of Bendigo nearly to Bealiba, a distance of nearly 40 miles, and from near Maryborough northwards to Inglewood, a distance of about 25 miles. He considered the material from 40 localities, much of it "in an extremely poor state of preservation, so that in a large number of cases it was not possible to determine the fossils; still, from most localities, a sufficient number of identifications were made to fix the age of the beds approximately."

From a couple of miles east of Bealiba to Laanecoorie the rocks appear to be entirely of Lancefieldian age and this has been proved north and south along their strike for 15 miles. About 15 miles north of the east and west Bendigo-Bealiba line is found at Inglewood, slightly to the east of the Laanecoorie strike *Tetragraptus decipiens* and *Clonograptus* sp., suggesting Lancefieldian and *Tetragraptus approximatus* hitherto only found in association with *T. fruticosus* at Bendigo and Dromana. "Its presence, then, may be taken to indicate on the one hand the top of the Lancefield, and, on the other, the base of the Bendigo series, and the two series pass into one another without a break." He details the serial occurrences east and west of the Inglewood strike and the Bealiba-Laanecoorie belt and also those at Marong.

He concluded that "the age of the rocks about Dunolly, in the middle of the Bealiba-Laanecoorie belt, is Lancefieldian, then on the Inglewood-Campbelltown-Smeaton strike we reach the higher Bendigonian series. The eastward continuation of this, between Llanelly and Marong, is basalt masked, but Bendigonian is again met with at Marong, and possibly still farther to the eastward."

He reported (70) on graptolites from Sebastian, which he placed in the Castlemaine Series (they are now known to belong to the Darriwil Series) and from several localities at Bendigo, Chewton, Dunolly, Bromley, Barp, Waanyarra, Goldsborough, Bet Bet, Tarnagulla, Elaine, Inglewood, Wedderburn (?), Moolort, Deep Creek (Parish of Bullarook), Eganstown, Wombat, Rocky Lead, and localities in the Parishes of Dean, Bullarook, Creswick, Smeaton, Clarendon, Painswick, Ballarat district, Woodend, Mansfield, Kevington district, Myrtleford district, Nowa Nowa, Mt. Wellington district, and Accommodation Creek.

He described and figured *Trichograptus fergusoni* sp. nov.,

Dichograptus octobrachiatus, Clonograptus abnormis and *C.* sp.

1913.—In 1903 J. W. Gregory[1] divided the Silurian of Victoria into two series, viz.: the Melbournian and the Yeringian, and Chapman (71) added the Tanjilian. From the Melbournian Chapman (71) recorded *Dendrograptus* sp., *Monograptus* cf. *concinnus, M.* cf. *cyphus, M.* cf. *dubius, M. priodon;* from the Yeringian, *Cyrtograptus* sp., *Monograptus priodon, M. riccartonensis,* and *Retiolites australis;* and from the Tanjilian (?) *Cyrtograptus* sp., *Monograptus* cf. *crenulatus* and *M. dubius.* N. R. Junner (74) found *Climacograptus* and *Diplograptus* in black, pyritic slates at the Diamond Creek Mine.

1914.—W. R. Browne (75) gave a list (supplied to him by C. F. Laseron) of graptolites found by the latter in Wambrook Creek, near Cooma, New South Wales. The list is more detailed than that previously given (66) and comprises *Diplograptus foliaceus* (very abundant), *Climacograptus bicornis, C. hastata* (very abundant), *Dicellograptus elegans, D. caduceus, D. affinis* and (?) *Pleurograptus.* He stated that *Tetragraptus, Didymograptus* and *Diplograptus* occur in slates at Geygedzerick Hill, 2¼ miles north-east of Berriedale, indicating the existence of the higher series of the Lower Ordovician in New South Wales. He also mentioned that C. F. Laseron had found in the neighbourhood of Cobargo, about 44 miles a little south of east of Cooma, *Diplograptus foliaceus, Climacograptus, Dicellograptus* (?) *gracilis* and *D. affinis.*

T. S. Hall (76) described and figured *Didymograptus extensus, D. perditus* sp. nov., *D. gracilis, D. aureus* sp. nov., *D. latens* sp. nov., *D. procumbens* sp. nov., *D. adamantinus* sp. nov., *D. mundus* sp. nov., *D. dilatans* sp. nov., *D. bifidus, D. caduceus* var. *manubriatus* nov., *Oncograptus* gen. nov., *O. upsilon* sp. nov., *Goniograptus macer, G. speciosus* sp. nov., *G. crinitus* sp. nov., *G. laxus* sp. nov., *Tetragraptus harti* sp. nov., *T. whitelawi* sp. nov., *Monograptus aplini* sp. nov., *M. turriculatus, M. priodon, Triaenograptus neglectus* gen. et sp. nov.

He reported (77) on graptolites from 11 localities in the Steiglitz District and 40 localities in the Bendigo District.

Chapman (79) gave the stratigraphic subdivisions of the Lower Ordovician of Victoria, based on T. S. Hall's researches on graptolites (28). He also summarized the

1. 1903 Gregory, J. W., The Heathcotian—A Pre-Ordovician Series—and its Distribution in Victoria, Proc. Roy. Soc. Vict. (n.s.) xv, (II), pp. 148-175. Melbourne.

Lower Ordovician of New Zealand, the Upper Ordovician of Victoria and New South Wales, and the Silurian of Victoria. He states that graptolites have been recorded from Tasmania, but that the horizon and the locality is uncertain.

He figures many of the better-known graptolites from the Ordovician and Silurian.

1915.—T. S. Hall (80) stated that the graptolite-bearing rocks of Victoria occupy about 20,000 square miles. The Upper Ordovician strata range north from eastern Victoria 300 miles into New South Wales. He expressed the opinion that the Victorian, not the British, sequence will be found in New Zealand. "Broadly," he continued, "the sequence of Australian graptolites agrees with the European, but in details is closer to that of New York, as Ruedemann has pointed out. The important differences in the range of *Didymograptus bifidus, D. caduceus, D. nicholsoni, Loganograptus, Clonograptus rigidus* and some other genera and species negative the idea that graptolite zones are world-wide, and as no one believes that all the genera and species originated in one locality and radiated thence, this is what we should expect."

1916.—W. J. Harris (81) worked on an area in the Castlemaine District somewhat more extensive than that previously worked by T. S. Hall (28). He examined all but three or four of the outcrops visited by Hall and paid tribute to the accuracy of the latter's observations. He revised Hall's subdivisions of the Castlemaine and defined the Darriwil. The subdivisions proposed by Harris were as follows:

Series and Division	*Locality of Typical Development*	*Zone Fossils*	*Other Characteristic Fossils*
Darriwil (W. J. Harris and T. S. Hall)			
Upper	Guildford-Strangways Road	*Glossograptus* sp. indet. *Trigonograptus* *Lasiograptus* (absence of *C. morsus*)	*Diplograptus* cf. *angustifolius.* *D. gnomonicus* sp. nov. *Didymograptus caduceus.* *D. v-deflexus* sp. nov.
Middle	Guildford-Strangways Railway	*C. morsus* *Trigonograptus* (absence of *Oncograptus*)	*Diplograptus gnomonicus* sp. nov. *Didymograptus caduceus* *D. v-deflexus* sp. nov. *Phyllograptus* sp.

Series and Division	*Locality of Typical Development*	*Zone Fossils*	*Other Characteristic Fossils*
	Chinamen's Creek	*C. morsus* ` *Oncograptus* *Trigonograptus*	*Diplograptus gnomonicus* *Didymograptus caduceus* *D. v-deflexus* sp. nov. *Phyllograptus* sp.
Lower	Woodbrook Road	*Oncograptus upsilon* *Trigonograptus* (absence of *C. morsus*)	*Didymograptus caduceus* *D. v-deflexus* *Phyllograptus* sp. *Didymograptus caduceus* var. *manubriatus*
Castlemaine Upper	McKenzie's Hill	*Didymograptus caduceus* (max. dev.) *Loganograptus logani*	*Didymograptus* spp. *Diplograptus* spp.
	Victoria Gully	*Didymograptus caduceus* (absence of *Phyllograptus typus*)	*Dichograptus* cf. *octonarius* *Diplograptus* spp.
Middle	Victoria Gully East	*Didymograptus caduceus* (small) *Phyllograptus typus*	*Dichograptus* cf. *octonarius* *Clonograptus* sp.
	Burns Reef	*P. typus* (absence of *D. bifidus*)	*Clonograptus* sp.
Lower	Wattle Gully	*D. bifidus* (absence of *Tetragraptus fruticosus*)	*Phyllograptus typus* *P.* cf. *angustifolius* *Dichograptus octobrachiatus* *Clonograptus* spp. *Goniograptus crinitus* *Tetragraptus pendens* *T. similis*
Bendigo Upper	Daphne Reef	*Tetragraptus fruticosus* (3-branched)	As in Wattle Gully Beds and *Goniograptus macer* *G. thureaui*
Middle	South Fryerstown Race	*Tetragraptus fruticosus* (4-branched)	*Goniograptus macer* *Tetragraptus pendens* *T. similis* *Phyllograptus* cf. *typus* *Didymograptus latus*

He recorded beds of the Darriwil Series "as previously constituted", for the first time from the Castlemaine District. He extended the meaning of the term Darriwil to include not only the beds hitherto placed in it by T. S. Hall, but beds in the district between them and the Upper Castlemaine (Logano-caduceus) zone all of which he had found in the Darriwil district. He retained the Castlemaine Series as fixed by T. S. Hall although to him the two zones of the Middle Castlemanian are not always distinguishable. He divided the Bendigo beds at Castlemaine into two, one characterized by the three branched *Tetragraptus fruticosus* and the other by the four-branched. He stated that *T. fruticosus* (three-branched) and *Didymograptus bifidus* are found associated at Tarilta and other places. He defined his new conception of the Darriwil, the nature of its facies, its stratigraphical position, particularly in regard to the evidence afforded by the development of *Didymograptus caduceus* in both the Darriwil and Castlemaine Series, transitional beds and subdivisions.

He published a zone map and sections, also figures of *Cardiograptus morsus* gen. et sp. nov., *Diplograptus gnomonicus* sp. nov. and *Oncograptus biangulatus* sp. nov.

1918.—F. Chapman (82) described some hydroid remains belonging to the Calyptoblastea from black slate or shale, two miles east-north-east of North Monegeeta, south of Romsey. He inferred from the presence of *Acrotreta antipodium* that the beds were probably of similar age to the Lancefieldian of the Mt. William and Lancefield districts.

1919.—E. O. Teale (83) found in the Howqua River area graptolites on either side of the main diabase area there. On the western side, only Upper Ordovician *(vide* 156 *post)* and, possibly, Silurian graptolites occur. He searched assiduously where the *Monograptus* identified by T. S. Hall was stated to have been found, but did not find a single specimen of that genus, though hundreds of forms of less restricted range, chiefly *Climacograptus* and *Diplograptus* and probably *Glossograptus* were obtained.

On the eastern side, in thin black slates, he obtained *Tetragraptus* and *Didymograptus,* indicating a Lower Ovdovician horizon. Some distance upstream from the last locality, a few chains west of Eight-mile Creek, he found indistinct graptolites, suggesting *Diplograptus* and *Climacograptus.*

The same author gave (84) a useful synoptic table of Upper Ordovician assemblages recorded from Victoria. He added to the list from Mt. Wellington (52) *Diplograptus foliaceus,*

D. quadrimucronatus, D. calcaratus, Leptograptus flaccidus, Climacograptus bicornis var. *tridentatus, C. tubuliferus, Dicellograptus morrisi, D. gurleyi, Cryptograptus tricornis, Nemagraptus gracilis* and *Lasiograptus margaritatus.*

F. Chapman and E. W. Skeats (85) published what is largely a duplication of Chapman's paper (82) on the hydroids from North Monegeeta. They state that somewhat similar branching forms occur with *Dinesus ida* and other trilobite remains probably of Cambrian age near Heathcote, 30 miles to the north.

1920.—T. S. Hall (86) added to his list (63) of the Upper Ordovician forms from Tolwong *(vide* 159 *post),* New South Wales, *Leptograptus flaccidus, Dicellograptus complanatus* et var. *ornatus, D. morrisi, D.* cf. *caduceus, Dicranograptus ramosus* var. *semispinifer, D. hians, Climacograptus caudatus* var. *wellingtonensis, C.* cf. *tubuliferus, Diplograptus theilei, D. linearis, Glossograptus* sp., *Lasiograptus (Neurograptus)* cf. *fibratus,* (?) *Retiograptus geinitzianus* and Retiolitidae fragt. He added notes on *Diplograptus (M.) linearis, Climacograptus tubuliferus* and *C. caudatus* var. *wellingtonensis.*

R. A. Keble (87) described and figured *Tetragraptus approximatus* Nich., *T. acclinans* sp. nov. and *T. decipiens* T. S. Hall.

A. V. James (88) gives Upper Ordovician and Silurian graptolite localities on his map of the Bulla-Sydenham area in addition to those indicated on Quarter Sheets 1 NW., 7 SE.

No specific determinations of the graptolites he obtained from them are given.

1921.—L. F. Harper (89) recorded from Yalgogrin, New South Wales, *Climacograptus hastatus, Dicellograptus* cf. *affinis* and fragmentary forms comparable with *D. caduceus.*

W. J. Harris and W. Crawford (90) published lists of graptolites obtained from numerous specified localities in the Gisborne District. They represent collections from the Bendigo, Castlemaine and Darriwil Series and the Upper Ordovician. *Dicellograptus smithi* was recorded for the first time in Victoria.

A tentative recognition of three Upper Ordovician graptolite zones was proposed:

1. *Diplograptus-Didymograptus* Zone (lowest).
2. *Dicellograptus* Zone.
3. *Dicranograptus* Zone.

They stated that the Riddell Grits overlie the *Dicranograptus* shales (Upper Ordovician) and they underlie the

Kerrie Conglomerate. They suggested that the age of the Kerrie Conglomerate is basal Silurian.

1923.—T. S. Hall (91) recorded from Phosphate Hill, Mansfield, *Tetragraptus decipiens* and *T. approximatus*.

R. A. Keble (92) recorded the same species from Phosphate Hill, Mansfield, and placed them in the Upper Cambrian in conformity with American stratigraphy.

H. Herman (93) published zone maps and sections of the Bendigo Goldfield based on a subdivision of the Bendigo Series published therewith.

H. S. Summers (95) listed the graptolites from the Bacchus Marsh and Coimadai District and he (96) reviewed the evidence for the age of the Kerrie Conglomerate and gave lists of graptolites from Allot. 20, Parish of Newham; Allot. 5, Parish of Macedon; and Allot. 48A, 109 and 114, Parish of Kerrie.

E. W. Skeats (97) gave faunal lists in the Lancefield and Romsey districts. Most of the species had already been recorded (23, 24, 27, and 39). From the Bendigo Series, however, on the northern boundary of Allot. 49, Parish of Goldie, he recorded *Tetragraptus fruticosus* (3 and 4 branched), *Goniograptus macer* and *Phyllograptus*. In the railway cutting two miles east of Kilmore Gap he recorded Silurian species and he stated that *Monograptus* had been found two miles south-east of the cutting.

1924.—W. J. Harris (98) described and figured *Didymograptus v-deflexus* sp. nov., *Lasiograptus* (*Thysanograptus*) *etheridgei* sp. nov., *Retiograptus speciosus* sp. nov., *Climacograptus riddellensis* sp. nov., *Glossograptus hincksi, Didymograptus (Isograptus) caduceus*. He described and commented on *Cardiograptus* gen. and *C. morsus* sp., *Oncograptus biangulatus, Diplograptus gnomonicus, Trigonograptus ensiformis* and *Thamnograptus capillaris*.

Diplograpsus mucronatus (13) was relegated to the synonymy of *Lasiograptus* (*T.*) *etheridgei, Diplograptus rectangularis* (14) to *Climacograptus riddellensis* and *Diplograpsus mucronatus* (14) to *Glossograptus hincksii*.

F. Chapman (99) gave a systematic list of Tanjilian fossils in which he includes *Cryptograptus* sp., *Monograptus* cf. *crenulatus, M.* (?) *dubius* ("in Jordan River series") and *M.* cf. *jaekeli*. In regard to this list he adds the following note: "doubtfully included here. Occurring in the typical Walhalla Series, and high in that series, plant remains occur." (*Cryptograptus* is probably written in error for *Cyrtograptus*.)

In some critical remarks on the flora and fauna, he states: "Graptoloidea have been reported on by the late Dr. T. S. Hall. Some of the forms are rather high in the series, as compared elsewhere, and on account of their indifferent preservation, may require revision. Besides the first three on the list, determined by Dr. Hall, I have found the predominant graptolite supposed to belong to the Walhalla plant-bearing beds, to be a form related to *Monograptus* cf. *jaekeli* Perner, of the *M. priodon* type. Dr. T. S. Hall's plesiotypes of *M. dubius,* which have been examined by Mr. W. J. Harris and myself, belong to a form of the *M. priodon* type."

1925.—R. A. Keble (101) recorded from Allot. 28, Parish of Langwarrin *Climaçograptus* sp., probably of Upper Ordovician age; from the Howe's Creek Phosphate Mine, in a trench on Allot. 113A, Parish of Loyola, *Monograptus leptotheca, M. mcCoyi, M.* cf. *cutellus, M.* cf. *proteus, M.* spp. nov., *Climacograptus* sp., *Diplograptus* sp., and *Retiograptus* sp. He regarded the age as equivalent to the Llandovery of Britain.

From a locality north of Greendale he recorded *Didymograptus aureus, Tetragraptus fruticosus* (4 and 3 branched), *T. bryonoides, T.* cf. *quadribrachiatus, T.* cf. *acclinans, Dichograptus octobrachiatus,* and *Goniograptus laxus.*

From the Lerderderg River, between the river and the headwaters of Rum Creek, Parish of Blackwood, he recorded *Didymograptus aureus, D. latens, D. extensus, Tetragraptus fruticosus* (4 branched), *T. pendens, T. decipiens, T. harti, T. serra* and *Phyllograptus angustifolius.*

R. A. Keble and W. J. Harris (102) recorded a number of species from Mt. Easton (incorrectly referred to as Eastern). *Diplograptus calcaratus* var. *vulgatus* and *Leptograptus capillaris* were recorded for the first time in Victoria. They described and figured *Climacograptus missilis* sp. nov., *C. exiguus* sp. nov., *Leptograptus flaccidus* var. *subjectus* nov., *L. eastonensis* sp. nov. and *Dicellograptus gravis* sp. nov. They show in a table the relative position of the Mt. Easton beds in relation to the British Zones.

W. Baragwanath (104) adopted the following provisional classification of the Silurian in the Aberfeldy District:

Upper Silurian

Walhalla Series.
Jordan River (and Donnelly's Creek) beds.

Lower Silurian

Mt. Useful beds.

He collected graptolites from a number of places in the area which were submitted to T. S. Hall for identification.

He obtained *Monograptus* in black slates in the valley of the Thomson for half a mile above the Jordan-Thomson River junction. Regarding these graptolites he quotes T. S. Hall, who states that "*Monograptus* seems to be the only genus represented, and, as far as the material allows of careful examination, only one species is present. With some hesitation, owing to the imperfection of the material, I identify this as *M. dubius* Suess. . ." From a spur one mile south of the Thomson-Jordan junction, Hall identified *M.* cf. *dubius* and *M.* sp. Commenting on the forms from a spur between Little Boy's and Bell's Clear Creek, he remarked on their poor preservation and that they appeared to belong to the sub-genus *Pristiograptus.* Certain specimens had thecae of the "*priodon*" type. The forms from a spur a mile south of the last locality were likewise inconclusive.

From a locality near the last one, two specimens (Nos. 547 and 548) submitted to him provoked considerable comment. "No. 547," Hall says, "is a *Monograptus,* and is therefore a Silurian form, whereas No. 548 is a *Didymograptus,* having the aspect of *D. caduceus.* The cast of the sicula can be clearly seen, and the reverted apertural denticles of the thecae are visible. Of the generic position of the fossil there can be no question. The matrix, an indurated micaceous mudstone, appears the same as that of many of the other specimens from the same spur, but I feel convinced that the presence of the Lower Ordovician type in association with Monograptidae is an error due to human agency. With the exception of this fossil, the whole of the rest of the fossils (Nos. 522-538 and 547) are of Silurian age."

To this he added a footnote. "In face of Mr. Baragwanath's personal assurance that there was no confusion of localities in these two specimens, but that both came from the same block of stone, I have requested permission to re-examine them. I see no reason to alter my opinion as to their generic position. I have, moreover, explained the case to Mr. F. Chapman, A.L.S., and he has examined the supposed *Didymograptus.* He allows me to say that he agrees with my identification. Further specimens are urgently required from this locality as the inferences to be drawn are too important to rest on a couple of very indistinct fossils."

In view of the above, a further search was made in the same place and from the resulting specimens, T. S. Hall identified *Monograptus* cf. *dubius* Suess, *M.* cf. *crenulatus* Torn. (genus

Monoclimacis Frech), *M.* sp. (*colonus* group), *M.* sp. and (?) *Monograptus* or *Cyrtograptus.*

From the Thomson River valley at a blazed tree, 23 chains south of the southern boundary of the map, Hall identified *M.* cf. *dubius,* and *M.* sp.

The graptolites from the Upper Ordovician have been reviewed (53, 56, 102).

1926.—W. J. Harris (105) described and figured *Didymograptus nodosus* sp. nov., *Cardiograptus crawfordi* sp. nov., *Cryptograptus tricornis,* Atopograptidae fam. nov., *Atopograptus* gen. nov., *A. woodwardi* sp. nov. He commented on an assemblage from a locality north of Gisborne and one at Bendigo East, both high in the Lower Ordovician and possibly the highest yet recorded.

1927.—O. A. Jones (107) recognized the presence of *Monograptus chimaera, M. colonus, M. romeri* and *M. varians* at Studley Park, Melbourne. He showed that they indicated an horizon equivalent to that of the *M. nilssoni* Zone of the Lower Ludlow and were younger than the graptolites recorded from South Yarra, Macclesfield and Keilor.

1928.—R. A. Keble (108) examined two of the slabs from the Ring River, Tasmania, previously examined by T. S. Hall (48) and recorded a Dichograptid fragment, (?) *Tetragraptus* sp., (?) *Leptograptus* sp., (?) *Syndyograptus* sp.

W. J. Harris and R. A. Keble (109) described and figured *Staurograptus diffissus* sp. nov., *Dictyonema campanulatum* sp. nov., and *D. scitulum* sp. nov., from a band of blue slate at Lancefield. They regarded the bed as the oldest graptolite-bearing bed yet found in Australia and later (121) placed it at the base of the Ordovician.

E. W. Skeats (110) reviewed the field evidence regarding the occurrence of Silurian and Ordovician rocks in the Walhalla-Woods Point District where Etheridge[1] had noted traces of primitive plants in marine shales. As a result of the detailed study of the district by Herman,[2] Whitelaw,[3] Junner,[4] and Baragwanath,[5] the Silurian formations had been divided into the Lower (Mt. Useful), Middle (Jordan

1. Etheridge, R., Determinations of Palaeozoic and Mesozoic Fossils, Rec. Geol. Surv. Vict. 1 (1), p. 10. 1902.
2. Herman, H., Rep. on the Walhalla Goldfield. Special Rep. Dep. of Mines, Victoria. 1901.
3. Whitelaw, O. A. L., The Wood's Point Goldfield, Mem. 3, Geol. Surv. Vict. 1905, and The Topography, Geology and Mines of the Wood's Point District, ibid., 13. 1905.
4. Junner, N. R., The Geology of the Ore Deposits of the Walhalla-Woods Point Auriferous Belt, Proc. Aust. Inst. Min. & Met. (n.s.) 39. 1909.
5. Baragwanath, W., The Aberfeldy District, Gippsland, Mem. 15, Geol. Surv. Vict. 1925.

River) and Upper (Walhalla) divisions. The Jordan River beds had been held by Junner[6] to contain *Monograptus* in the lower portion of the Penenka shales with plant remains in the upper portion, while others were of the view that the plants were contained within graptolite bearing beds. Chapman[7] expressed doubts concerning this and believed that the plant-bearing Penenka shales were actually of Lower Devonian age, and rested on the Walhalla beds, in the lower portion of which was a Yeringian or Upper Silurian fauna. Skeats, however, confirmed the inferior position of the plant-bearing beds in regard to the Walhalla series, and confirmed the reported association of plants and graptolites in the Jordan River shales. An illustration of this was afforded by Keble (128) who identified a graptolite that occurred on the same slab as plants as *Monograptus riccartonensis* and relegated the series to the Zone of *M. riccartonensis* of the lower Middle Silurian of Britain. Subsequently a more extensive series of forms were studied by Elles (139) who referred them to the *M. nilssoni* Zone of the European early Upper Middle Silurian. The associated Psilophytales were described by Lang and Cookson (139).

1929.—R. A. Keble and W. N. Benson (111) published a correlation table showing that the graptolite succession in North-west Nelson, New Zealand, agreed with that in Australia. They described and figured a number of new species, some of which have since been found in Australia.

O. M. B. Bulman (112) published a useful paper dealing with the genotypes of graptolite genera. His comments in regard to Australian genera are as follows:

"*Atopograptus,* Harris, 1926, p. 59, genotype *A. woodwardi.*". (*vide* 105.)

"*Cardiograptus,* Harris & K., 1916, genotype *C. morsus* Harris & K. Possibly referable to *Phyllograptus* Hall." (*vide* 81.)

"*Goniograptus,* McCoy, 1876, genotype, *Didymograptus thureaui* McCoy." (*vide* 17.)

"*Oncograptus,* T. S. Hall, 1914, genotype, *O. upsilon,* T. S. Hall. Possibly best regarded as a subgenus of *Didymograptus,* McCoy." (*vide* 76.)

"*Triaenograptus,* T. S. Hall, 1914, genotype *T. neglectus,* T. S. Hall." (*vide* 76.)

E. W. Skeats (113) recorded graptolites from Tabberabbera at localities indicated on his map of the area.

1930.—W. J. Harris and R. A. Keble (114) identified from

6. Junner, N. R., *supra cit.*

7. Chapman, F., On the Question of the Devonian Age of the Tanjilian Fauna, Rep. Aust. Ass. Adv. Sci., xvii. 1926.

the Federal Territory, *Dicellograptus* cf. *gravis, D.* cf. *gurleyi, Dicranograptus furcatus* cf. var. *minima, Diplograptus calcaratus* var. *vulgata, D. ingens* and *Climacograptus tubuliferus.*

W. S. Dun (115) stated that certain areas at Narrandera, New South Wales, regarded as Devonian, were Ordovician, containing *Diplograptus.* He thought that most of the Palaeozoics between Narrandera and Albury were of Ordovician age.

1931.—W. R. Browne (116) recorded *Diplograptus (? Climacograptus) bicornis* from a locality south of Cooma, New South Wales.

O. M. B. Bulman (117) described and figured a number of species from South America. Commenting on the multiramous Dichograptids and the Phyllograptids having such a a high stratigraphical position in South America, he pointed out that the discrepancy is less when comparison is made with the Lower Ordovician faunas of eastern North America and Australia than with those of Europe. In regard to T. S. Hall's remark (40) that secondary branches of *Goniograptus macer* give off tertiaries on alternate sides, he said that an alternative is that *G. macer* is only an abnormal and incomplete example of what he terms *Loganograptus logani* var. *kjerulfi.*

He described *Dichograptus octobrachiatus* var. that resembles the form described by McCoy in 1874 (14). He also described and figured under *Didymograptus (Isograptus) caduceus* Salter, emend. var., a form comparable with the large V-shaped *D. caduceus* recorded by Harris (81).

1932.—G. L. Elles (119) published, with T. W. Edgeworth David's explanatory notes to accompany a new geological map of the Commonwealth of Australia, a correlation table of Australian with extra-Australian graptolite zones. She correlated the Australian Zones with what she considered their British, and American serial and zonal equivalents. She gave what she considered the Australian equivalents of many British species. T. W. Edgeworth David stated that G. L. Elles believed that the sequence of graptolite zones in Australia was practically the same as that in Europe.

R. A. Keble (120) published, with T. W. Edgeworth David's notes, a synoptic table of the Victorian Lower Ordovician graptolite zones and a table in which the Darriwil, Castlemaine, Bendigo and Lancefield Zones were elevated to series each of which was subdivided into five zones. Typical zone localities, restricted and common zone fossils are given. T. W. E. David said that Keble considered "that the grapto-

lite succession of Australia differs from that of Europe, and more closely resembles that of America, where, in the opinion of Ruedemann, the succession differs from that of Europe. T. W. E. David (118) deals with the Upper Ordovician rocks at Omeo and Mitta Mitta in Victoria which he states pass into New South Wales where, he says, they "lie in several parallel belts, of which the most easterly nearly follows the coast line to Batman's Bay, and thence perhaps trends inland to Tallong, near Marulan. The rich gold-bearing saddle-reefs of Hargreaves traverse Upper Ordovician rocks. The most westerly belt as yet proved strikes from the Forbes-Parkes area to Tomingley and Myall Reefs, also a gold-bearing zone."

He defines the limits of the Ordovician sea and the direction of the old shore-line. "East of this shore-line," he says, "there is a great development of Ordovician rock of a pelagic graptolite type belonging to this sea. These extend southward into Tasmania and northward into New South Wales right up to the Queensland border. This sea, probably continuous with the Larapintine Sea, spread over much of eastern Queensland as well, but so far no fossils have been found belonging to the eastern extension of the sea, except in the south-east extremity of the State, near Point Danger. There a *Diplograptus* has been identified in the local Brisbane schists, which there belong to either the top of the Ordovician (?) Bunya Series or to the base of the Silurian (?) Neranleigh Series. A long intermittent belt of Upper Ordovician rocks, characterized by veins of turquoise and other hydrous phosphates, extends from the Ovens River, Victoria, through Bodalla and Murwillumbah in New South Wales, the Neranleigh and Bunya Series of Brisbane, and the cherts of Gladstone and Yeppoon, to Innisfail, south of Cairns, Queensland. The uniform character of this phosphate zone suggests a more or less continuous development of Upper Ordovician rocks, along the eastern sea-board of Australia, for the distance of about 1,700 miles."

In regard to the Silurian, he gives a tentative correlation of the Silurian rocks of the Commonwealth. The graptolite assemblages of Victoria are, for the "Studley Park Bed," *Monograptus nilssoni* and *M. colonus;* the "Jordan Series," *M. priodon, M. dubius, Retiolites australis;* the "Keilor Beds"(upper part), *Monograptus riccartonensis;* the "Keilor Beds" (lower part), *M. turriculatus, M. exiguus, M. aplini;* the "Mount Useful Series" of the Walhalla Geosyncline, *M. convolutus.* He records Monograptids in the Hume Beds of

New South Wales and *Diplograptus* sp. in the Neranleigh Series of the Brisbane Series, an occurrence that he assigns to an horizon about the Valentian of Britain.

Third Period: 1932 to Present.

This may be termed the period of systematization. In 1932 the graptolite fauna was well enough known to subdivide the Lower Ordovician strata into series and zones, but the problem confronting systematists was where to fix their limits. It was known that the zones as constituted by T. S. Hall had not been based on the best principles of zoning, but it was difficult to adjust them without causing confusion. In 1932 W. J. Harris and R. A. Keble (121) systematized the subdivision of the Lower Ordovician largely on the basis laid down by T. S. Hall. They elevated his zones to series and subdivided each of these series into five zones.

W. J. Harris (138) suggested a further subdivision of the Darriwil, and he and D. E. Thomas (157) revised the subdivisions of all previous workers and added new series.

1932.—The systematization of the Victorian Lower Ordovician succession by W. J. Harris and R. A. Keble (121) is as follows:

DARRIWIL SERIES.

Zone	*Typical Locality*	*Zonal Species*	*Associated Forms*
D1	Bendigo East	Didymograptus nodosus Atopograptus woodwardi Brachiograptus etaformis	Cardiograptus crawfordi Climacograptus Didymograptus caduceus (rare) Phyllograptus nobilis Lasiograptus Glossograptus Diplograptus Cryptograptus tricornis Trigonograptus ensiformis Tetragraptus quadribrachiatus
D2	Loc. 7SZ Geol. Surv. Vic. Sutherland's Creek Steiglitz	Diplograptus austrodentatus	D. caduceus Trigonograptus Glossograptus C. tricornis Tetragraptus
D3	Castlemaine-Maryborough Railway W. of Strangways	Cardiograptus morsus	D. caduceus D. v-deflexus Tetragraptus Phyllograptus Diplograptus gnomonicus Trigonograptus

Zone	*Typical Locality*	*Zonal Species*	*Associated Forms*
D4	Chinamen's Creek, Muckleford	Cardiograptus morsus Oncograptus	D. caduceus D. v-deflexus Trigonograptus Phyllograptus Tetragraptus Strophograptus trichomanes D. gnomonicus
D5	Castlemaine-Walmer Rd. E. of borough Boundary, Castlemaine	Oncograptus upsilon	Much as in D4 D. forcipiformis Goniograptus speciosus
		CASTLEMAINE SERIES.	
C1	McKenzie's Hill, Castlemaine, water race in paddock N. of Castlemaine-Maldon Rd.	D. caduceus (maximum development)	Loganograptus logani Diplograptus sp. Didymograptus uniformis Tetragraptus quadribrachiatus
C2	Victoria Gully, Castlemaine	D. caduceus (sub-maximal development)	Diplograptus sp. Didymograptus spp. Dendroid forms Dichograptus cf. octonarius
C3	Victoria Gully, east of the Type locality of C2	D. caduceus (small forms) Phyllograptus cf. typus	Comparatively few
C4	Burns Reef, Chewton	P. cf. typus D. caduceus (small and rare)	Comparatively rare
C5	Wattle Gully, Chewton	D. bifidus	D. caduceus (small) Clonograptus spp. D. octobrachiatus Phyllograptus Goniograptus laxus G. crinitus Tetragraptus similis T. pendens
		BENDIGO SERIES.	
B1	Paddy's Gully, Bendigo	Tetragraptus fruticosus 3-br. D. bifidus	D. octobrachiatus Phyllograptus cf. typus Clonograptus abnormis Tetragraptus similis T. quadribrachiatus G. laxus
B2	Napoleon Syncline, Bendigo	T. fruticosus 3-br.	Much as in B1 Didymograptus similis Goniograptus thureaui D. extensus

Zone	*Typical Locality*	*Zonal Species*	*Associated Forms*
B3	Red, White and Blue Reef, Bendigo	T. fruticosus 3-br. and 4-br.	Didymograptus dilatans D. extensus Goniograptus thureaui T. pendens
B4	Garden Gully, Bendigo	T. fruticosus 4-br.	T. similis T. serra Clonograptus spp.
B5	Hustler's Hill, Bendigo	T. fruticosus 4-br. T. approximatus	D. aureus T. decipiens T. quadribrachiatus T. acclinans Loganograptus logani Clonograptus tenellus
	LANCEFIELD SERIES.		
L1	Bull Dog Creek, Mornington Peninsula	T. approximatus	T. decipiens T. quadribrachiatus T. acclinans C. tenellus
L2	Lancefield, near Deep Creek	Bryograptus victoriae T. decipiens	Clonograptus tenellus
L3	Lancefield Quarry, N.E. of Old Mt. William Railway Station	Dictyonema macgillivrayi B. victoriae	T. decipiens Clonograptus spp. Didymograptus pritchardi D. taylori
L4	North east of Romsey	Dictyonema campanulatum D. scitulum Staurograptus diffissus	No associates have been found
L5	Not yet recognized in Victoria	(Dictyonema)	

Commenting on the limitation of the Bendigo Series by the advent and extinction of *Tetragraptus fruticosus,* they say that "before dealing with each series and its zones in detail attention may well be called to a point which is of importance in all attempts at zoning, and which has been well expressed by Dr. Elles.[1] That experienced graptolithologist, from her extended study of British graptolite zones, writes: 'some commingling at the boundaries of the zones must naturally

1. Elles, G. L., The Characteristic Assemblages of the Graptolite Zones of the British Isles, Geol. Mag. lxii, pp. 337-347. 1925.

be expected, especially when dealing with the succession of purely shaly deposits, but as a rule even then the coming in of new forms in abundance should be taken as an index of the passage to a higher horizon. This fact is one upon which great emphasis should be laid; it is upon this, the coming in of new forms, usually indicative of a more advanced stage in evolution, that the basis of modern zonal stratigraphy is laid; the persistence of old forms tends to vary greatly in different localities. There does not appear to be any justification for action which results from focusing too much attention upon the index fossil rather than upon the assemblage, which is the determining factor'."

A short history of graptolite research was published and a correlation of the Victorian zones with those in the Northern Hemisphere.

They described and figured *Diplograptus (Glyptograptus) austrodentatus* sp. nov., *Phyllograptus nobilis* sp. nov., *Didymograptus forcipiformis, D. dependulus* sp. nov., *Brachiograptus etaformis* gen. et sp. nov., and *Goniograptus palmatus* sp. nov.

E. A. Ripper (122) indicated the distribution of the zones of the Castlemaine and Darriwil Series at Ingliston, near Bacchus Marsh. She found in the Darriwil Series Zone D2 characterized by the zone fossil *Diplograptus austrodentatus, Glossograptus* sp. and absence of *Cardiograptus morsus;* D3, characterized by *C. morsus* and the absence of *Oncograptus;* D4, with *Cardiograptus morsus* and *Oncograptus* sp.; D5-4, with *Oncograptus biangulatus* and *O. upsilon* and D5 with *O. upsilon* and the absence of *Cardiograptus.* In the Castlemaine Series she found Zone C1 with *Didymograptus caduceus* (maximum development) and *Oncograptus* absent.

She published detailed maps and sections.

D. E. Thomas (123) gave lists of graptolites from Lower and Upper Ordovician localities in the area to the north and north-west of Riddell and including parts of the Parishes of Kerrie, Monegeeta and Rochford. The localities are indicated by symbols on the map published with the paper. He records for the first time in Australia *Diplograptus (Amplexograptus)* cf. *arctus, D.* cf. *pageanus, Climacograptus minimus, C. putillus* cf. mut. *eximius* and *Dicellograptus forchammeri* var. *flexuosus.*

1933.—D. E. Thomas and R. A. Keble (126) published a comprehensive paper on the Bulla-Sunbury area and discussed the Silurian sequence in the Melbourne area. They outlined the history of ideas concerning the Silurian and

Ordovician systems and incidentally explained McCoy's conception which guided his investigations on Victorian Palaeozoic fossils when he was appointed Palaeontologist to the Geological Survey of Victoria in 1856 and during the next three decades. They also gave a number of sections and lists of fossils from localities indicated by numbers on the plans published with the paper, and also from localities on the Quarter Sheets. They suggest a revised serial subdivision of the Upper Ordovician, viz., (1) the Gisbornian Series (the oldest), (2) the Eastonian Series, and (3) the Bolindian Series. Lists of typical fossils from each of these series were supplied, together with a table of ranges of both Upper Ordovician and Silurian species. They compared the Victorian species with the British and showed their points of agreement as well as their differences.

They discussed the Ordovician-Silurian boundary west of Melbourne and in other parts of Victoria, particularly in regard to the anomalies that have arisen in previous work. The stratigraphy of the Silurian in and near Melbourne as hitherto worked out is discussed at length. The basis of palaeontological subdivision, particularly that of J. W. Gregory when he divided the Silurian into two series, viz., the Melbournian (the lowest) and the Yeringian, is reviewed. They showed that the evidence conflicts with that of the palaeontology and stratigraphy of the Melbourne area—the type locality of the Melbournian, which is high in the Silurian and the equivalent of the British Ludlow, and the area to the west. They proposed a revised subdivision in which they erected a new series, viz., the Keilorian, and substituted the term Yarravian for Gregory's Melbournian. They considered the sequence to be—

3. Yarravian.
2. Yeringian.
1. Keilorian (oldest).

The name Yarravian is suggested in place of Melbournian owing to the confusion that must inevitably arise from the previous assumption that the Melbournian represents the lowest subdivision of the Silurian. The Yeringian is taken as the equivalent of the Wenlock on the authority of McCoy and Chapman. The Keilorian is characterized by the first appearance of the Monograptidae and comprises all those beds preceding the incoming of *M. riccartonensis,* which marks the beginning of the overlying series. On its characteristic graptolites the Yarravian (= Melbournian)

may be correlated with the Llandoverian (Valentian) of Britain.

The following species were recorded, many for the first time:

L., Lower Ordovician; G., Gisbornian; E., Eastonian; B., Bolindian; K., Keilorian; Yer., Yeringian; Y., Yarravian.

Didymograptus caduceus, L. G.
var. ovatus, G.
Tetragraptus quadribrachiatus, L.
tabidus, L. G.
clarkfieldi, G.
Cryptograptus tricornis, L. G. E.
Glossograptus hincksii, L. G.
acanthus, L. G.
hermani, L. G.
pilosus, L. G.
Lasiograptus sp., L. G.
Climacograptus riddellensis, L. G.
antiquus, G.
var. bursifer, G.
lineatus, G.
simulans, G.
bicornis, G. E.
var. peltifer, G.
brevis, G.
scalaris (? var.), B., K.
var. miserabilis, B.
normalis, B.
minimus, E.
cf. exiguus, E.
tubuliferus, E.
putillus var. eximius, E.
stylodeus, B.
supernus, B.
missilis, E., B.
uncinatus, B.
caudatus, E. B.
Diplograptus (Orthograptus) cf. bellulus, E.
calcaratus, E. B.
var. acutus, E. B.
basilicus, E. B.
priscus, G. E. B.
vulgatus, G. E.
insectiformis var. vagus, B.
cf. pageanus, E.
quadrimucronatus, E. B.
var. spinigerus, B.
truncatus, E. B.
var. abbreviatus.
intermedius, E. B.
pauperatus, E.
socialis, E. B. K.
D. (Glyptograptus) sinuatus, B.
tamariscus, B. K.
teretiusculus, L. G.
var. siccatus, G.
euglyphus, L. G.
D. (Mesograptus) foliaceus, G?
magnus, K.
modestus, K.
multidens var. nov., G.
ingens, G. E. B.
D. (Amplexograptus) coelatus, L. G.
perexcavatus, G. E. B.
Retiograptus pulcherrimus, B.
speciosus, G.
latus?, G.
Dicranograptus zic-zac?, G. E.
furcatus var. minimus, G. E. B.
nicholsoni, G. E.
ramosus, G. E.
var. longicaulis, E. B.
spinifer, G. E.
brevicaulis, G.
hians, E.
var. apertus, E.
Dicellograptus sextans, G.
caduceus, B.
complanatus, B.
var. ornatus, E. B.
divaricatus, G. E.
elegans, E. B.
var. rigens, E. B.
forchammeri, E. B.
intortus, G.
moffatensis, E.
pumilus, B.
gravis, E. B.
affinis, B.
didymus, B.
latusculus, B.
Leptograptus flaccidus, E. B.
var. subjectus, E. B.
eastonensis, E. B.
capillaris, E. B.
Nemagraptus gracilis, G.
Pleurograptus linearis var. dispansa, B.
Monograptus bohemicus, Y.

aplini, K.
chimaera, Y.
colonus, Y.
var. compactus, Y.
comis, Y.
concinnus, K.
dubius, Yer. Y.
exiguus, K.
fimbriatus, K.
galaensis, K., Yer.
griestonensis, Yer.?
gregarius, K.
jaculum, K.
marri, K. Yer.
melbournensis, Y.
nilssoni, Y.
pandus, K.
priodon, K. Yer.
romeri, Y.
sedgwicki, K.
spiralis var. permensis, K.
turriculatus, K.
varians, Y.
var. pumilus, Y.
vulgaris var. curtus, Y.
Retiolites (Cladograptus) geinitzianus, K.
Stomatograptus australis, K.

Numerous plans and sections are published with the paper.

W. J. Harris (127) erected the new family Isograptidae and subdivided it into the genera *Isograptus* (Moberg), *Oncograptus* (T. S. Hall), *Cardiograptus* (Harris & K.), *Skiagraptus* gen. nov., and *Meandrograptus* (Moberg). He fixed as the genotype of *Isograptus, D. caduceus* (Salter), thus conceding priority to Salter's specific name. He pointed out that *I. caduceus* and its allies are "the most easily followed of graptolite phylogenetic series and they are the most reminiscent of the best-known palaeontological phylogenies."

In the genus *Isograptus* he places *I. forcipiformis, I. hastatus* sp. nov., *I. manubriatus* (T. S. Hall partim), *I. dumosus* sp. nov., and *I. ovatus* (T. S. Hall). The genotype of *Oncograptus* is *O. upsilon,* and in this genus he placed *O. biangulatus.* The genotype of *Cardiograptus* is *C. morsus,* and in the genus he placed *C. crawfordi.* The genotype of *Skiagraptus* is *D. gnomonicus.* The genotype of *Meandrograptus* is *M. schmalenseei* Moberg, and in this genus he placed the Victorian species *M. aggestus* and *M. tau* spp. nov. He stated "that unity is given to the whole by progressive development along several lines" which he specifies with examples, as follows:

1. The rhabdosome becomes increasingly scandent.
2. Progression and then regression in the form of the thecal aperture.
3. Concrescence, the more important.

He commented on the ancestry of *Isograptus caduceus.* He published a table showing the stages in the hypothetical development of that genotype and allied forms.

Stage 1 shows a progressive increase in the size of the rhabdosome, accompanied by more open spacing of the thecae, angle of divergence, downward direction of apertural

mucros, and the completeness of the thecal overlap. Stage 2 is characterized by deployment into allied genera. *Oncograptus upsilon* and *Cardiograptus morsus* are the only forms that do not seem distinctly paracmic and even these are very variable. The stage is marked by tendency towards reduction in size with closer thecae, still increasing angle of divergence leading to biserial forms, variation in mucros, reduction of thecal overlap in manubriate forms, grouping of thecal origins in sicular region as distinct from concrescence, but shown with concrescence in forms like *Oncograptus* and *Cardiograptus*. Stage 3 is marked by extinction of the group except for rare examples. The evidence is insufficient to place *Maeandrograptus aggestus* and *M. tau*. The catagenetic varieties of *I. caduceus* except *I. caduceus* var. *divergens* are not shown in the table. They are commonest in Zones C1 and D5, and show great variability, making grouping difficult. Practically all agree in distally-narrowing stipes.

He then dealt with *Isograptus caduceus* and its varieties, also with their stratigraphical horizons, with other varietal forms, manubriate species, *Isograptus forcipiformis* and *Skiagraptus gnomonicus, Oncograptus* and *Cardiograptus* and their development, *Macandrograptus* spp. and other species. He concluded with remarks on the correlation and zonal range of the Isograptidae.

He defined the new family Isograptidae and gave an amended diagnosis of the genus *Isograptus*. He described and figured *I. manubriatus, I. hastatus* sp. nov., *I. ovatus*. He commented on the genus *Macandrograptus* and described and figured *M. tau* sp. nov. and *M. aggestus* sp. nov. He described *Skiagraptus* gen. nov. and described and figured *S. gnomonicus*. In conclusion he described and figured *Didymograptus eocaduceus* sp. nov. and *D. hemicyclus* sp. nov.

He supplied a page of text figures and a plate.

R. A. Keble (128) described the occurrence of graptolites and vascular plants on a single slab of shale from the Yarra Track, west of Matlock. He identified the graptolite as *Monograptus riccartonensis* (cf. 139) and the plant as belonging to the genus *Psilophyton*. The occurrence of *Monograptus* with vascular plants definitely fixes their age as Silurian and establishes them as the oldest vascular plants yet recorded.

1934.—W. J. Harris and D. E. Thomas (129) contributed a paper on the geological structure of the Lower Ordovician rocks of (the County of) Eastern Talbot.

The distribution of the graptolite series and their relation to the axial lines were discussed. A section showing the graptolite zones was given. The relation of the auriferous zones to structure was considered and the authors came to the following conclusions regarding auriferous quartz reefs in the various zones:

1. The Darriwil beds have so far been uniformly barren.
2. The upper beds of the Castlemanian have contained productive fault reefs. Occasional saddle-reefs are known, but productive spurry reefs are more characteristic.
3. The Bendigo horizon contains numerous productive saddle reefs in addition to productive spurry reefs.
4. Auriferous saddle reefs occur in beds of the Lancefield horizon, but "indicator" gold is more characteristic.

The principal graptolite localities were listed.

W. J. Harris (130) stated that to the east of the central or gold-fields area of Bendigo Ordovician strata higher in the series than those of the central area have long been known. He discussed a number of traverses across the boundary between these higher and lower beds and shows that if the localities are plotted "it is seen that the dividing line between the high Darriwilian beds to the east and the Lancefieldian beds to the west (probably Bendigonian in the southwest) is an almost straight line bearing about N. 15° W. and traceable about 14 miles or more. . . . The only practicable explanation of this seems to be faulting" for which he suggests the name Whitelaw Fault. He estimated that "the thickness of missing beds would be about 12,000 feet measured vertically or perhaps 5,000 feet measured at right angles to the dip."

R. A. Keble and W. J. Harris (131) figured and described *Didymograptus acriculus* sp. nov., *D. mendicus* sp. nov., *Tetragraptus chapmani* sp. nov., *T. decipiens* var. *bipatens* nov., *Pterograptus lyricus* sp. nov., *Climacograptus uncinatus* sp. nov., *C. subminimus* sp. nov., *Diplograptus* (*Glyptograptus*) *euglyphus* Lapw., D. (G.) *euglyphus* var. *sepositus* nov., *D. (Amplexograptus) perexcavatus* Lapw., *Trigonograptus* sp., *Glossograptus pilosus* sp. nov., *Cryptograptus circinus* sp. nov., *Retiograptus pulcherrimus* sp. nov., *Monograptus aplini* T. S. Hall emend. Keble & H., *M. spiralis* (Geinitz) var. *permensis* nov., *M.* cf. *scanius* Tullb., *M. pandus,* and *Stomatograptus australis* (McCoy).

K. Sherrard (132) exhibited at the Royal Society, Sydney, New South Wales, *Monograptus colonus* var. *compactus* and

M. cf. *nilssoni* from the Parish of Derrengullen, Yass District, New South Wales.

R. Ruedemann (133) stated that Australia, New Zealand and China have furnished graptolite faunas that are closely related to those of North America. In dealing with Palaeozoic seas and palaeo-geographic problems, he stated that "conclusions, at present only preliminary and based upon uncompleted survey of the graptolite faunas of North America, confirm the presence of a Pacific Ocean as an independent centre of evolution. This is evidenced by the presence of such genera as *Cardiograptus* and *Oncograptus* and various species that occur in the Pacific (Australia, British Columbia, Idaho and Texas) but not in the Atlantic province. The presence of these genera and species in the Cordilleran geosyncline leaves no doubt of its connection with the Pacific Ocean, at least periodically."

1935.—W. J. Harris and D. E. Thomas (134) described and figured a number of species, viz., *Pterograptus incertus* sp. nov., *Trichograptus immotus* sp. nov., *Tetragraptus defensus* sp. nov., *Didymograptus cognatus* sp. nov., *D. distinctus* sp. nov., *D. cuspidatus, D. compressus* sp. nov., *D. dubitatus* sp. nov., *D. nodosus, Diplograptus* (*Glyptograptus*) *austrodentatus, D.* (*G.*) *intersitus* sp. nov., *D.* (*G.*) cf. *euglyphus,* (?) *Mesograptus decoratus* sp. nov., *Amplexograptus modicellus* sp. nov., *A. confertus, A. differtus* sp. nov., *Glossograptus acanthus,* (?) *G. crudus* sp. nov., (?) *G. crudus* var. *gisbornensis* nov., *Cryptograptus schaferi, Lasiograptus* (*Hallograptus*) *proteus* sp. nov., *Lasiograptus* (*Thysanograptus*) *etheridgei, Cardiograptus crawfordi.*

D. E. Thomas (135) stated that the lithology of the Victorian Ordovician is consistent throughout, sandstones, shales, grits and mudstones alternating.

He gave a table showing the graptolite subdivisions of the Ordovician System of Victoria suggested by Harris and Keble and by Thomas and Keble, and supplemented it with a more detailed account of each zone and its graptolite assemblages. He gave the distribution and structure of the Lower and Upper Ordovician rocks and referred to the period of faulting and folding.

F. Chapman and D. E. Thomas (136) dealt with the distribution of the Silurian system, its lithographical types, relation to older and younger rocks, sequence, occurrence in the Walhalla, Heathcote, and Melbourne districts and its contained fossils both graptolites and others. They retained the name Melbournian on account of its priority over Yarra-

vian and considered the sequence to be Keilorian, Melbournian, and Yeringian, the Keilorian being the oldest. They correlated the Keilorian with the Lower Silurian or Llandovery Series of Britain; over these beds, at Keilor, come beds with *Monograptus riccartonensis,* indicating Middle Silurian or Wenlock age. They correlated the Melbournian with the Lower Ludlow Series of the Upper Silurian of Britain, and the Yeringian with the Upper Ludlow.

They discussed the lithological characters and fossil contents of the Keilorian, Melbournian and Yeringian in the Melbourne-Lilydale-Upper Yarra district as well as in other parts of Victoria.

W. J. Harris (138) in an important contribution discussed an area including the Parishes of Wellsford, Strathfieldsaye and Sedgwick with adjacent portions of other parishes, particularly in regard to the Darriwilian. He gave the general distribution of the graptolite series and an outline of the zoning of the Darriwilian as high as the D2 Zone. He contended that the incoming of the Diplograptidae in force in the D2 Zone marks a very important stage in the graptolite succession and discussed the relationship of the D2 beds to the lower zones. He described five sections from east to west across the area, and showed that there is a normally descending series of beds to the Whitelaw Fault, and that above the D2 horizon two zones may be distinguished with possible passage beds, (a) a zone characterized by *Diplograptus* (*Glyptograptus*) *intersitus* and *Didymograptus compressus,* and (b) a higher zone characterized by *Diplograptus* (*Mesograptus*) *decoratus* and *Didymograptus nodosus.* These zones may be recognized throughout the area. He maintained that field and biological evidence fixes the position of the zones already mentioned and that elsewhere in Victoria a higher zone in the Lower Ordovician can be recognized, while the basal graptolite bed of the Upper Ordovician (as at Ba 67 Quarter Sheet 6 SE.) should also be included in a *Diplograptus* series. In regard to the zoning of the Darriwilian and Castlemanian in Victoria, he stated that the grouping of zones from D2 to basal Upper Ordovician inclusive, as a *Diplograptus* series, leads to an attempt to treat lower beds in the same way. He states that the breaks between the typical series are largely artificial and suggests that the zones below the *Diplograptus* series, i.e., from D3 downwards to C4 (inclusive) may be regarded as an *Isograptus* series. Immediately below this series are passage beds characterized by *Didymograptus protobifidus* Elles, while

below these again the Bendigo Zones form a *Tetragraptus fruticosus* series.

DIPLOGRAPTUS SERIES

(In the following table, c = common, r = rare, v = very)

Zone of *Diplograptus* (*Glyptograptus*) *teretiusculus* (highest).

Typical locality: Ba 67 at junction of Riddell's and Jackson's Creeks (Q.S. 6 SE.).

Characteristic assemblage:

Diplograptus teretiusculus His. (v.c.).
euglyphus Lapw. (c.).
Climacograptus riddellensis Harris (c.).
Cryptograptus tricornis Carr. (c.).
Glossograptus hincksii Hopk. (c.).
Retiograptus speciosus Harris (c.).
Isograptus caduceus var. tenuis Harris var. (v.r.).
Didymograptus (horizontal spp.) (c.).
Pterograptus lyricus Keble & H.

Zone of *Diplograptus* (*Glyptograptus*) *euglyphus*.

Typical localities: Turner's Quarry; Eight-Mile, Howqua River.

As above, except that *Diplograptus teretiusculus* has not been recognized with certainty, *Tetragraptus* is more common, and *Retiograptus speciosus* not yet recorded. *Isograptus ovatus* occurs at both typical localities, though elsewhere it seems to be an Upper Ordovician form.

Zone of *Diplograptus* (*?Mesograptus*) *decoratus* (*D.* aff. *coelatus*).

Typical localities: Loc. 164 Strathfieldsaye; loc. 300, Sedgwick; Allot. 8, Sec. XXIX Huntly.

Diplograptus (?Mesograptus) decoratus Harris & T. (v.c.).
D. (Amplexograptus) confertus Lapw. (c.).
differtus Harris & T. (c.).
modicellus Harris & T. (c. locally).
Cryptograptus schaferi Lapw.
Lasiograptus proteus Harris & T.
Isograptus forcipiformis (Rued.).
Cardiograptus crawfordi Harris.
Brachiograptus etaformis Harris & K.
Trigonograptus ensiformis J. Hall.
Didymograptus nodosus Harris (v.c.).
dubitatus Harris & T.
cognatus Harris & T.
cuspidatus Rued.
acriculus Keble & H.
Atopograptus woodwardi Harris.
Phyllograptus nobilis Harris & K. (v.c.).
Tetragraptus spp.

In what are probably the lower beds of this zone, *D. decoratus, D. nodosus* and *Lasiograptus etheridgei* are the commonest species as, e.g., at loc. 176 and north-west of Turner's Quarry. A similar assemblage, with *Didymograptus nodosus,* very rare, is found at Woodend (Allot. 95, 99) and at Newham (Sec. 20).

Zone of *Diplograptus (Glyptograptus) intersitus.*
Typical localities: Loc. 196, 210 Strathfieldsaye; 298 Sedgwick.
Diplograptus (Glyptograptus) intersitus Harris & T. (v.c.).
Lasiograptus etheridgei Harris (v.c.).
Isograptus forcipiformis (Rued.).
caduceus var.
Cardiograptus crawfordi Harris (c.).
Cryptograptus schaferi Lapw.
Glossograptus acanthus Elles & W.
Trigonograptus ensiformis J. Hall.
Didymograptus compressus Harris & T. (c.).
spp.
Tetragraptus spp.
Pterograptus incertus Harris & T. (c.).
Phyllograptus sp.
Loganograptus cf. logani J. Hall (v.r.).
Zone of *Diplograptus austrodentatus* (D2).
Typical localities: Loc. 310 Sedgwick; Guildford-Strangways Road; Brisbane Ranges.
Characteristic assemblage.

ISOGRAPTUS SERIES

Zone of Cardiograptus morsus (D3).
„ „ Cardiograptus and Oncograptus (D4).
„ „ Oncograptus (D5).
„ „ Isograptus caduceus var. maxima et var. maximo-divergens (C1).
„ „ I. caduceus var. victoriae (C2).
„ „ var. lunata (C3, C4).

DIDYMOGRAPTUS PROTOBIFIDUS PASSAGE BEDS

Zone of Didymograptus protobifidus and Isograptus caduceus var. primula et lunata (C5).
„ „ Didymograptus protobifidus and Tetragraptus fruticosus (B1).

TETRAGRAPTUS FRUTICOSUS SERIES
(Bendigonian Zones)

He correlated the *Diplograptus* series with the Llanvirnian of Britain and suggested that the correlation of beds immediately below these will probably be facilitated by a study of the Victorian extensiform *Didymograpti.*

He published a map with notes, a section, an index to graptolite localities and a list of references.

W. H. Lang and I. C. Cookson (139) contributed a paper on the flora, including vascular land-plants, associated with *Monograptus,* in rocks of Silurian age. They submitted the associated graptolites to G. L. Elles, who identified *M. uncinatus* var. *orbatus* from the Yarra Track beds and *M. chimaera, M. uncinatus* var. *orbatus* et var. *micropoma* from the Alexandra beds; she regarded the assemblage typical of a Lower Ludlow horizon (110 and 128).

G. F. K. Naylor (141) indicated on a map of the Goulburn District, New South Wales, Upper Ordovician localities yielding *Climacograptus, Diplograptus, Dicranograptus* and *Dicellograptus.* From a locality on the Bungonia-Goulburn Road, about three miles west of Bungonia, he recorded Lower Silurian forms comparable with *Monograptus barrandei* and *M. exiguus.* He also recorded from a locality on the main Sydney Road near the Towrang turn-off *Monograptus* of an Upper Silurian type. D. E. Thomas (*ibid.* p. 80) suggested that it was *M. bohemicus* and probably contemporaneous with the zone of *M. nilssoni.* Naylor himself tentatively determined another form as *M. nilssoni.*

W. N. Benson and R. A. Keble (142) wrote on the geology of the regions adjacent to Preservation and Chalky Inlets, Fiordland, New Zealand, and correlated the New Zealand assemblages with those of Victoria. They described and figured a number of species, some of which were new and should occur in Victoria. In particular, they referred *Leptograptus antiquus* T. S. Hall to the genus *Bryograptus.*

1936.—G. F. K. Naylor (143) recorded from a locality between the third and fourth mile-posts on the Bungonia-Goulburn Road (presumably the locality mentioned in 141) *Monograptus exiguus* and *M. barrandei* and in addition *M. undulatus, M.* cf. *decipiens, M.* cf. *tortilis.* He recorded from the Upper Ordovician *Diplograptus quadrimucronatus* and *D. calcaratus* var. *tenuicornis.*

He described and figured from more or less specified localities *Monograptus bohemicus, M. exiguus, M.* cf. *decipiens, M. undulatus, M.* cf. *tortilis, Diplograptus* (*Orthograptus*) *quadrimucronatus* and *D.* (*O.*) *calcaratus* var. *tenuicornis.* He described *M. barrandei.*

R. A. Keble (144) recorded and figured from the Bendigo Series a form in which the flat spiral polypary and thecae growing upwards in a single linear series seemed to him to leave no other alternative than to place it among the Monograptidae.

O. M. B. Bulman (145) made serial sections and dissections of the graptolites of the Holm Collection from which he made wax models and traced their history and evolution by a close study of the initial part of the rhabdosome. This important work threw considerable light on such peculiarly Australian genera as *Brachiograptus* Harris & K., *Cardiograptus* Harris & K., *Goniograptus* McCoy, *Oncograptus* T. S. Hall and many cosmopolitan genera.

He also investigated (146) by serial sectioning and grind-

ing two specimens of *Oncograptus* from the El Paso Limestone (Canadian) of Marathon, Texas, United States, preserved in semi-relief in impure limestone. He showed "that *Oncograptus* can have no close relation to *Isograptus* but is derived from a Tetragraptid in which the mode of development had not progressed to the minutus stage of the Dichograptid type, where th.2^1 is produced from th.1^1, opposite and approximately at the same level as th.1^2. It hardly seems probable that a proximal end with the structure of *Oncograptus* could progress further towards the Diplograptid type of development and hence that *Cardiograptus* (assuming this to be its completely biserial descendant) could be an ancestor of any 'normal' Diplograptids."

F. Chapman and D. E. Thomas (147) recorded Cambrian Hydroida from Heathcote and Monegeeta Districts. New genera, species and varieties described and figured are *Archaeocryptolaria recta* Chapm. var. *flexilis* nov., *Archaeolafoea serialis* sp. nov., *A. fruticosa* sp. nov., *Protohalecium* gen. nov., *P. hallianum* sp. nov., *Sphenoecium* gen. nov., *S. discoidalis* sp. nov., *Cactograptus flexispinosus* sp. nov., *C. plumigerus* sp. nov., *Acanthograptus candelabrum* sp. nov.

1937.—P. Ekström (148) described and figured *Phyllograptus nobilis* Harris & K. and used it as a subzonal fossil in Norway.

A. Monsen (149) described and figured many Australian forms that had been found in the Norwegian graptolite shales such as *Dictyonema macgillvrayi, Didymograptus* cf. *aureus, D.* cf. *perditus, Tetragraptus* cf. *harti, T. decipiens* and *Goniograptus* aff. *palmatus.* Monsen compares the Australian succession as given by Harris and Keble (121) with the Norwegian succession and adds a synoptic table correlating the Norwegian with the Swedish, English, North American, Australian and Bohemian zones.

K. Sherrard and R. A. Keble (150) recorded graptolites from specified Upper Ordovician localities in the Parishes of Morumbateman, Mundoonen and Manton, near Yass, New South Wales. They gave a correlation table of the Yass occurrences with other places in New South Wales. From the Silurian beds near Yass, they recorded *Monograptus flemingi, M.* cf. *tumescens, M.* cf. *nilssoni, M.* cf. *vomerinus* and *Dictyonema* sp. They stated that "the graptolite bed overlies the Limestone Creek beds and incidentally the Barrandella shales . . . the succession seems to be quite conformable and undisturbed . . . Hence the age of the Limestone Creek beds and the Barrandella shales, if Shearsby

and Sherrard are right in stating that they are the same bed, may be fixed by the graptolite bed, that is, they are Silurian, probably high Wenlockian." Descriptions and figures were given of both Upper Ordovician and Silurian forms, including *Retiograptus yassensis,* a new species.

E. A. Ripper (151) published a paper on *Didymograptus protobifidus.* After reviewing the Victorian pendent *Didymograpti,* she gave a description of *D. protobifidus* Elles. She stated that T. S. Hall "referred under the name of *D. bifidus* (J. Hall) to some forms which undoubtedly belong to this more primitive species." Transients are to be found in the Upper Bendigonian and Lower Castlemanian assemblages and a number of localities where they occur are specified.

She gave a comparative table of the specific characters and details of the evolutional changes of *D. bifidus* and *D. protobifidus,* also remarks on assemblages and correlations.

"After a careful comparison of Victorian and British specimens," she concluded, "the tuning-fork graptolite occurring most abundantly in the uppermost Bendigonian and Lower Castlemanian (B1 and C5) zones in Victoria is identified with *Didymograptus protobifidus* Elles."

She supplied a table showing the proposed correlation of the Victorian and British Lower Ordovician graptolite succession.

G. F. K. Naylor (152) in a preliminary note on the occurrence of Palaeozoic strata near Taralga, New South Wales, gave a map and sections of the district. In the basal sediments he found "generically recognizable specimens of *Diplograptus, Climacograptus, Dicellograptus* and *Dicranograptus* pointing unquestionably to the Upper Ordovician age of the beds."

Silurian beds occur in rather restricted lenticular bands folded in among the Ordovician strata. The two most prominent forms of graptolites occurring in them are *Monograptus bohemicus* and *M. chimaera.*

D. E. Thomas (153) published notes on the Silurian rocks of the Heathcote area. He gave a classification to which he attached local names. In his Dargile Beds the lower beds are unfossiliferous and are separated by some sandstone from the Graptolite Beds which also contain numerous shelly fossils. He divided the Graptolite Beds into:

(a) The lowest beds with *Monograptus uncinatus,* var., *M. colonus* var. *compactus* and fossils other than graptolites.
(b) These are succeeded by sandstones and mudstones and the former have

yielded corals and a starfish bed. With this a graptolite cf. *M. nilssoni* was found.

(c) The upper beds yielded abundant graptolites, *M. colonus* var. *compactus, M. uncinatus* var., *M. bohemicus* and *M. varians* and fossils other than graptolites.

W. J. Harris and D. E. Thomas (154) published descriptions and figures of the following species:

(a) From the Heathcote district—
Monograptus bohemicus, M. colonus var. *compactus, M. varians, M. uncinatus* var. *orbatus, M. uncinatus* var. *micropoma, M.* sp. aff. *nilssoni* and *M.* cf. *comis.*

(b) From the Kilmore district—
Diplograptus sinuatus, Climacograptus hughesi, Monograptus runcinatus, M. (?) *nudus, M. priodon, M. exiguus* (syn. *M. aplini* T. S. Hall), *M. spiralis* var. *permensis, M. dubius.*

(c) From the Yarra Track—
M. uncinatus var. *orbatus, M. uncinatus* var. *micropoma, M. vomerinus* and *M. vomerinus* var. *crenulatus.*

(d) From the Melbourne district—
M. crinitus, M. dubius.

1938.—W. J. Harris and D. E. Thomas (155) dealt with the basal Bendigo (B5) assemblage from Allot. 16A, Parish of Campbelltown. They stress some of the features shown by the assemblage:

"(i) Instability of branching, so that Dichograptid or Loganograptid forms with from six to sixteen branches occur, together with five or six branched forms otherwise indistinguishable from *Tetragraptus fruticosus* (*vide Bryograptus crassus infra*). Three branched forms which are apparently three-branched representatives of horizontal *Tetragrapti* are also found."

"(ii) A great variety of extensiform *Didymograpti* including a series with 'closed' apertural regions (*D. hirundo* type) without any evidence of ancestral history as they are quite distinct from the rare *Didymograpti* recorded from the next lower zone (L1).

"(iii) Abnormal *Clonograpti* of great size with distinctive thecae of the *Tetragraptus chapmani* type."

"The higher beds (B4) are also extremely interesting as from them we are able to record for the first time from Australia the genera *Trochograptus* and *Schizograptus*, both with abnormal features, while the three-branched forms referred to above are not uncommon. This list by no means

exhausts the interesting features presented by the present collections."

"Apart from the forms which may be called abnormal the most interesting feature of the B5 assemblage from Allot. 16A is the notable 'burst' of extensiform *Didymograpti* and, contrary to the conclusions drawn by Elles[1] from English collections, the commonest forms on this, the lowest Victorian horizon on which *Didymograpti* are common, are those with 'closed' proximal regions. In Victoria the only *Didymograpti* of the Upper Lancefieldian are the distinctive *D. taylori* and *D. pritchardi*. The horizontal forms which come in so suddenly in B5 persist to higher horizons, but the *D. hirundo* type does not range above B4 where it reaches its climax in *D. latus* var. *aequalis* nov."

"The B5 horizon corresponds with that of the reclined *Tetragrapti* of the zone of *D. extensus* as defined by Elles and this agrees with her earlier correlation. The same horizon has been noted in New Zealand but there, as at most localities in Victoria, the number of species seems limited and there is no indication of the 'burst' of horizontal Didymograpti. The lower Bendigonian 'burst' of new forms is preceded by the 'burst' of *Bryograpti* and *Clonograpti* in the Middle Lancefieldian (L3) described by T. S. Hall. In the L1 beds the incoming of the horizontal *Tetragrapti* such as *Tetragraptus approximatus* and *T. acclinans* does not alter the general aspect of the assemblage, but the entry of the dependent *Tetragrapti* such as *T. fruticosus* and the extensiform *Didymograpti* in B5 introduces important new elements. A comparison of the Lower Bendigonian with those assemblages from other countries which may be correlated best with that stage shows that local differences are probably more important than some European graptolithologists have been prepared to admit, and that schemes of development based on the appearances of forms in any one region may not stand the test of observation when applied to more distant fields."

Commenting on branching as a generic character of the Dichograptids, they stated that "the presence of so many Dichograptid forms with apparently transitional numbers of branches brings forcibly to notice the artificial distinctions such as divide *Loganograptus* and *Dichograptus, Trochograptus* and *Schizograptus* and even *Tetragraptus* (where three-branched forms have been included in a genus which by its name was meant for four-branched forms). . . . The

1. Elles, G. L. Summary of Progress, Geol. Surv. G. Brit. for 1932, II, 1932.

problem of the development of branching forms such as *Loganograptus* and *Dichograptus* is complicated in Victoria by the simultaneous appearance of so many variants in the one bed without any indication of them in lower zones. It is therefore impracticable as far as Victorian graptolites are concerned to account for the production of *Dichograptus* by the reduction of stipes of *Loganograptus* unless it is presumed that reduction commenced as soon as *Loganograptus* appeared. The two forms appear together in B5, *Dichograptus* then persists, though not as a common form, as high as the Middle Darriwil, while *Loganograptus* is hardly known to occur again (one or two specimens have been recorded) until the Upper Castlemaine zones are reached, in spite of the large collections that have been made from intervening horizons. We have already referred to five- and six-branched dependent forms, which in number of branches, resemble *Tetragraptus fruticosus,* the normal four-branched form of which also occur in the same bed. These forms, abnormal in nothing except in number of branches, we must by current usage separate as *Bryograpti* (*vide B. crassus infra*). Another example of reduced branching is shown by forms from the B5 and B4 horizons which have only three branches and have therefore a superficial resemblance to *Triograptus* Monsen. It seems clear, however, that the three-branched habit is not due to the typical *Triograptus* form of development but rather to the failure of a fourth branch to arise in a horizontal Tetragraptus such as *T. harti*; that is these forms represent the three-branched phase of a horizontal *Tetragraptus* in the same way as the three-branched *T. fruticosus* does of a dependent *Tetragraptus.* An alternative would be to derive them from *Trichograptus* by suppression of branches but the *Tetragraptus* explanation seems simpler.'' Specimens were figured in the present paper but the authors postponed fuller discussion.

The forms figured and described are: *Trochograptus australis,* sp. nov., *T. indignus* sp. nov., *T.* cf. *diffusus, Schizograptus incompositus* sp. nov., *S. spectabilis* sp. nov., *Sigmagraptus yandoitensis* sp. nov., *Trichograptus fergusoni, Bryograptus crassus* sp. nov., *Clonograptus rarus* sp. nov., *C. smithi* sp. nov., *C. ramulosus* sp. nov., *C. tenellus* var. *problematica* nov., *Dichograptus sedecimus* sp. nov., *Tetragraptus pendens, T. harti, T. triograptoides* sp. nov., *T. volitans* sp. nov., *T. approximatus, Didymograptus latus, D. latus* var. *aequalis* nov., *D. abnormis, D. hemicyclus, D. similis, D.* cf. *suecicus, D. vicinus* sp. nov. and *D. aspersus* sp. nov.

The same authors contributed (156) some notes on the geology of the Howqua valley. They published a map and a section from west to east. They identify specimens in collections made at certain specified Upper Ordovician (Gisbornian) and Lower Ordovician (Darriwilian, Bendigonian and Lancefieldian) localities. They discuss T. S. Hall's identification of *Monograptus*.

W. J. Harris and D. E. Thomas (157) summarize critically the older classifications, and propose a modification of that latest in use, in which more time-significance is attached to the entry in abundance or "bursts" of new groups of forms into the faunal sequence, and the enumeration of successive zones in the reverse order of their deposition, which crept into the older scheme, is avoided. Certain of the major series are redefined, new serial names are introduced, and a Middle Ordovician division is for the first time brought definitely into the classification. The following is a brief statement of the scheme, and the correlation of the new zones with the older, the zone numbers for which are given in inverted commas.

LOWER ORDOVICIAN

(As now restricted)

Lancefield Series or Lancefieldian

La1 Zone of *Staurograptus* and *Dictyonema*. ("L4".)

La2 Zone of *Bryograptus*.

La2a: Burst of *Bryograptus, Tetragraptus*, primitive *Didymograpti*, and large *Dictyonemas*. ("L3".)

La2b: No large *Dictyonemas* ("L2").

La3 Zone of *Tetragraptus approximatus* ("L1").

Bendigo Series or Bendigonian (as now restricted)

Be1 Zone of *Tetragraptus fruticosus*, four-branched. Entry of the zone fossil; survival of *T. approximatus* ("B5"). This is one of the most important bursts of Victorian graptolites.

Be2 Zone of *T. fruticosus*, four-branched. Absence of *T. approximatus* ("B4").

Be3 Zone of *T. fruticosus*, three-branched. Entry of *T. fruticosus*, three-branched, in force; survival of *T. fruticosus*, four-branched ("B3").

Be4 Zone of *T. fruticosus*, three-branched. Absence of *T. fruticosus*, four-branched ("B2").

Chewton Series or Chewtonian (a Series newly instituted)

Ch1 Zone of *Didymograptus protobifidus*. Entry of *D. protobifidus*. Survival of *T. fruticosus*, three-branched ("B1").

Ch2 Zone of *D. protobifidus*. Absence of *T. fruticosus*. ("C5").

Ch3 Zone of *Didymograptus balticus*. At present imperfectly known. Characterized by *Didymograpti* and *Phyllograpti*, and containing small forms of *I. caduceus* var. *lunata*. ("C4").

Castlemaine Series or Castlemanian (as now restricted)

Ca1 Zone of *Isograptus caduceus* var. *lunata.* Entry of *I. caduceus* var. *lunata* in force. ("C3").
Ca3 Zone of *Isograptus caduceus* var. *victoriae.* ("C2").
Ca3 Zone of *Isograptus caduceus* var. *maximus* and var. *maximo-divergens.* ("C1").

Yapeen Series or Yapeenian

(Formal acceptance of name previously suggested to include the lower portion of the Darriwilian)

Ya1 Zone of *Oncograptus.* ("D5").
Ya2 Zone of *Cardiograptus.* ("D4 and D3").

Middle Ordovician

(Term established, with usage rather different from that in Great Britain, to include the upper portion of the Darriwilian and one higher zone)

M.O.1 Zone of *Diplograptus* (*Glyptograptus*) *austrodentatus.* Entry of the *Diplograpti* in force. ("D2").
M.O.2 Zone of *D.* (*G.*) *intersitus* ("D1a")
M.O.3 Zone of *D.* (*G.*) *decoratus.* ("D1b").
M.O.4 Zone of *D.* (*G.*) *teretiusculus* (formerly considered basal Gisbornian). *Glossograptus hincksii* abundant, entry of *Climacograpti.*

Upper Ordovician

Regarding the Upper Ordovician, Harris and Thomas, commenting on the divisions of Thomas and Keble (126) into

3. Bolindian.
2. Eastonian.
1. Gisbornian.

state that:

1. Apart from the zone of *Glyptograptus teretiusculus,* which has been included in the Middle Ordovician, the zone of *Nemagraptus* and zone of *Climacograptus peltifer* represent the *Gisbornian.*
2. The lowest beds of the Eastonian were not ascribed to any definite zone, but the upper part was correlated with the zone of *Dicranograptus clingani.*
3. The Bolindian was stated to contain three characteristic assemblages—
   (a) At the base *Diplograptus quadrimucronatus, Dicellograptus elegans,* and *Climacograptus tubuliferus.*
   (b) *Pleurograptus* sp. characterizes the middle portion.
   (c) Still higher assemblages are characterized by *Retiograptus pulcherrimus,* while *Diplograptus sinuatus* and *D. tamariscus* are also present.

As a result of work in the Romsey and Emu Creek areas, Thomas subdivided the Upper Ordovician as follows:

Zone of *Dicellograptus* cf. *complanatus*
Zone of *Pleurograptus* } Bolindian

Zone of *Dicranograptus hians* Zone of *Climacograptus wilsoni* (according to Elles (119), 1932, this is *C. baragwanathi*, T. S. Hall)	Eastonian
Zone of *Climacograptus peltifer* Zone of *Nemagraptus gracilis*	Gisbornian

Work by D. E. Thomas in the Romsey area on the zoning of the Upper Ordovician corroborates this classification to a certain extent; but faulting in the sections, their limited extent, the absence of certain zones, and the difficulty of obtaining well preserved specimens make a comprehensive account of the zones rather difficult. The remarkable similarity of the zones in the Upper Ordovician of Australia to those of Great Britain is striking, and with further work it may even be possible to adopt the English classification. The zone of *Dicellograptus* cf. *companatus* appears to include the fauna of the zone of *Dicellograptus anceps* of the European classification. Elles[1] points out that the "zone of *Dicellograptus companatus* is conditional," and that "in Scandinavia a small form of *D. anceps* occurs with this fauna; so that in all probability it lies below the zone of *D. anceps.*" Harris and Thomas consider that until further detailed work is done, Thomas's subdivision of 1935 (135) should be adopted.

The characteristic assemblages are as follows:

Gisbornian.

The zone of *Nemagraptus* is easily identified by the incoming of *Nemagraptus, Dicellograptus sextans, D. divaricatus, Dicranograptus nicholsoni, D. zic-zac, Climacograptus bicornis, Hallograptus mucronatus,* and the various *Leptograpti.* The association is very similar in the next zone, but in it *Climacograptus peltifer* and *Mesograptus multidens* are very characteristic.

Eastonian.

The base of the Eastonian is characterized by abundant *Orthograpti.* In the zone of *Dicranograptus hians,* the zone fossil is abundant and *Climacograptus tubuliferus* is characteristic. *Dicranograptus clingani* occurs, but not in abundance. According to Elles, *Climacograptus baragwanathi* is synonymous with *C. wilsoni.*

Bolindian.

Pleurograptus is a rare form. *Orthograptus quadrimucronatus,* however, is very characteristic. The beds containing

1. Elles, G. L., Geol. Mag., lxxiv, 1937, p. 487.

this form are now included by Harris and Thomas in the Bolindian. Thomas and Keble (126) stated that this form occurred at the top of the Eastonian as well as at the base of the Bolindian. Harris and Thomas consider that the association of forms allies these beds more to the Eastonian than to the upper part of the Bolindian. Lithological changes appear in the Bolindian, so that in all probability it may be necessary to transfer this zone to the Eastonian, thus increasing the similarity with the British succession.

The higher beds of the Bolindian are included in the zone of *Dicellograptus* cf. *eomplanatus*. Three assemblages deserve mention in this zone:

(a) beds with the form identified as *D.* cf. *complanatus;*
(b) beds with *Retiograptus pulcherrimus, Leptograptus eastonensis* and *Climaeograptus uncinatus;*
(c) beds with *Glyptograptus tamariscus.*

The exact relationship is imperfectly known, but no *Dierano-graptus* has yet been found in these beds.

Harris and Thomas add a correlation of Victorian Ordovician zones with those of Great Britain, North America, Sweden, Norway, Bohemia, China and South America. They also include three plates of line drawings of the more important graptolites.

O. M. B. Bulman (158) comments on several graptolite genera that are found in Australia. *Goniograptus* with its four main zig-zag stipes (second order of dichotomy) from the angles of which undivided lateral branches are given off alternatively on both sides (the lateral branching being very regular both as regards interval and angle) might equally be considered as resulting from a regularly alternating dichotomous type of division. *Brachiograptus* has four main stipes, which form with the "funicle" the letter H, from the outer sides of which undivided lateral branches are produced. He comments on *Atopograptus* under the heading of *Didymograptus. Oneograptus* he considers is apparently derived from *Tetragraptus* by stipe reduction, but retains the two branches incorporated in the proximal end. *Cardiograptus,* in which the distal stipes have failed to develop, resembles *Oneograptus.*

He doubts the occurrence of *Diplograptus (sensu stricto,* i.e., *Mesograptus)* and *Amplexograptus* in Australia. He queries *Trigonograptus* as a member of the Diplograptidae. *Skiagraptus* is also queried as a member of the Diplograptidae, and he briefly defines it as having "biserial proximal

thecae pendent in position, later thecae becoming more horizontal." He relegates *Thysanograptus* to the synonymy of *Lasiograptus (senu stricto).*

Triaenograptus he places under ? Graptoloidea ineertae sedis describing it as having a "rhabdosome circular with radiating branches, from which paired lateral branches are repeatedly produced forming trident-like structures, adjacent lateral branches may unite to a single branch, from which paired laterals may again later be developed."

In regard to hydroids he includes under the Order Dendroidea, Family Dendrograptidae, Family Callograptidae, Family Acanthograptidae fam. nov. for the genera *Acanthograptus* and *Thallograptus,* and the Family Ptilograptidae of which the only genus is *Ptilograptus.* As a separate grouping he gives genera of uncertain systematic relationships, described as primitive graptoloids or dendroids, but having probably hydroid affinities; such are *Mastiograptus* and *Chaunograptus.* A genus which has been referred to the Dendroidea but with uncertain relationships is *Cactograptus.*

G. F. K. Naylor (159) has extended his study of graptolites in New South Wales by recording the presence of twenty-four Upper Ordovician species and varieties distributed through twenty-six localities and ten Silurian species and varieties in four other localities, the position of which are stated in terms of a grid-map covering 2,000 square miles of the Goulburn District, lying chiefly within the County of Argyle. He reaffirms his determinations of the occurrence of *Monograptus barrandei, M.* cf. *decipiens, M.* cf. *tortilis* and *M. undulatus,* on which some doubt had been expressed by Thomas (141). He also suggests that the locality Tallong named in the title of T. S. Hall's paper (63) was a misprint for Tolwong, the name appearing in the title of the second paper (86) on fossils from the same district.

Subdivisions Proposed by Various Authors.

Silurian.

Gregory, 1903 *vide* p. 39	*Chapman, 1913* (71)	*Chapman & Thomas, 1935* (136)	*Thomas & Keble, 1933* (126)
Yeringian Melbournian	Tanjilian Yeringian Melbournian	Yeringian Melbournian Keilorian	Yarravian = Melbournian Yeringian Keilorian

Ordovician.

Thomas & Keble, 1933 (126)	*Hall, 1895 (28) Harris & Keble, 1932 (121)*	*Harris & Thomas, 1938 (157)*	
Bolindian Eastonian Gisbornian		Bolindian Eastonian Gisbornian	Upper Ordovician
	Darriwilian		Middle Ordovician
		Yapeenian	Lower Ordovician
	Castlemanian	Castlemanian	
		Chewtonian	
	Bendigonian	Bendigonian	
	Lancefieldian	Lancefieldian	

Species and Synonyms of Graptolites.

Abbreviations.

aff.	related to	Keble & B. .	Keble & Benson
auct. non. . .	not author	Keble & H. .	Keble & Harris
Barr.	Barrande	Lapw. . . .	Lapworth
Brongn. . . .	Brongniart	Linn.	Linnarson
Carr.	Carruthers	Murch. . . .	Murchison
cf.	compare	Nich.	Nicholson
Chapman & T.	Chapman & Thomas	nom. nud. . .	nomen nudum
desc.	description	Rued.	Ruedemann
Elles & W. .	Elles & Wood	syn.	synonym
emend.	emendation	Thomas & K.	Thomas & Keble
Eth.	R. Etheridge Jun.	Torn.	Tornquist
fig.	figure	Tull.	Tullberg
Harris & K. .	Harris & Keble	var.	variety
Harris & T. .	Harris & Thomas	var. nov. . .	new variety
His.	Hisinger	vide	see
Hopk. . . .	Hopkinson		

Species and Synonyms	*Reference in Bibliography*
Atopograptus woodwardi Harris . . .	105 (desc.), 112, 131, 134, 135, 138, 157, 158
Brachiograptus etaformis Harris & K.	121 (desc.), 135, 138, 157
Bryograptus antiquus T. S. Hall, cf. Leptograptus antiquus	39 (desc.), 40, 59, 69, 70, 87, 97, 111, 134, 135, 142, 156, 157
clarki T. S. Hall	39 (desc.), 40, 87, 97, 134, 135, 157
crassus Harris & T.	155 (desc.), 157
hunnebergensis Moberg	157
simplex Torn.	157
victoriae T. S. Hall	39 (desc.), 40, 59, 69, 70, 87, 97, 120, 121, 134, 135, 156, 157

Species and Synonyms	*Reference in Bibliography*
Callograptus salteri J. Hall	47 (cf.), 51 (cf.)
Cardiograptus crawfordi Harris	105 (desc.), 121, 127, 131, 134, 138, 157
morsus Harris & K.	81 (desc.), 90, 98, 105, 112, 119, 120, 121, 122, 127, 137, 138, 157
Cladograptus furcatus J. Hall, syn. of Dicranograptus furcatus	
ramosus J. Hall, syn. of Dicranograptus ramosus	
Clathrograptus geinitzianus J. Hall, syn. of Retiograptus geinitzianus	
Climacograptus affinis T. S. Hall	42 (desc.)
antiquus J. Hall	98, 126, 135, 157
var. bursifer Elles & W.	126
var. lineatus Elles & W.	126
var. simulans Thomas & K. M.S.	126
baragwanathi T. S. Hall, syn. of C. wilsoni	53 (desc.), 119
bicornis J. Hall	6, 8, 14, 19, 22, 30, 37, 38, 40, 46, 52, 53, 57, 63, 69, 70, 75, 84, 90, 102, 116, 123, 126, 134, 135, 150, 156, 157
var. longispina T. S. Hall	47 (desc.), 57, 84, 119
var. peltifer Lapw.	84, 90, 102, 123, 126, 134, 135, 157
var. tridentatus, syn. of C. bicornis	
brevis Elles & W.	126, 131
caudatus Lapw.	37, 69, 70, 84, 86, 123, 126, 134, 135, 157, 159
var. wellingtonensis, syn. of C. caudatus	86
coelatus Lapw., cf. Diplograptus coelatus	47
exiguus Keble & H.	102 (desc.), 123, 126 (cf.)
hastata T. S. Hall	47 (desc.), 51, 75, 84, 89
hughesi (Nich.)	153
innotatus Nich.	51 (cf.), 84 (cf.)
mensoris T. S. Hall	53 (desc.), 84, 102, 119
minimus Carr.	123, 126, 131
miserabilis, *vide* C. scalaris var. miserabilis	
missilis Keble & H.	102 (desc.), 131
normalis Lapw.	42
putillus var. eximius Rued.	123, 126 (cf.)
quadrangularis McCoy, syn. of C. riddellensis Harris	
rectangularis McCoy, syn. of C. riddellensis.	14, 19, 30, 34, 37, 159
riddellensis Harris	98 (desc.), 123, 126, 131, 138, 156, 159
scalaris His.	126, 157, 159
var. miserabilis Elles & W.	126
var. normalis Elles & W.	126 (cf.)

Species and Synonyms	*Reference in Bibliography*
scharenbergi Lapw.	126 (cf.)
simulans *vide* C. antiquus, var. simulans	126
stylodeus Lapw.	126 (cf.)
subminimus Keble & H.	131 (desc.)
supernus Elles & W.	126, 159
tubuliferus Lapw.	46, 47, 51, 53, 84, 86 (cf.), 114, 126, 131, 134, 135, 157
uncinatus Keble & H.	126, 131) (desc.), 157
wellingtonensis T. S. Hall	52 (desc.), 84, 102
wilsoni Lapw.	83, 84, 119, 134, 135, 157
Clonograptus abnormis J. Hall	23, 27, 61, 69, 70, 90, 120, 121
flexilis J. Hall	23, 27, 37, 39, 40, 43, 57 (?), 59, 61 (?), 69, 70, 87, 97, 121, 134, 135, 157
gracilis J. Hall	59
magnificus Pritchard	23 (desc.), 27, 28, 37, 39, 40, 56, 57, 59, 69, 70, 87, 97, 120, 157
ramulosus Harris & T.	155 (desc.)
rarus Harris & T.	155 (desc.)
rigidus J. Hall	23, 39, 40, 43, 57, 59, 69, 70, 78, 80, 87, 97, 131, 134, 135, 156, 157
var. tenellus, *vide* C. tenellus	
var. typicus (? nom. nud.)	67, 68
smithi Harris & T.	155 (desc.)
tenellus Linn. cf. C. rigidus var. tenellus	39, 40, 43, 56, 57, 59, 69, 70, 87, 97, 120, 121, 127, 131, 134, 135, 145, 156, 157
var. problematica Harris & T.	155 (desc.)
Coenograptus gracilis J. Hall, syn. of Nemagraptus gracilis (*quod vide*)	6, 8, 11, 16
Cryptograptus circinus Keble & H.	131 (desc.), 157
schaferi (Lapw.)	157
tricornis Carr.	52, 53, 57, 63, 70, 84, 90, 98, 102, 105, 120, 121, 123, 126, 132, 138, 145, 150, 156, 157, 159
tricornis, var. insectus Rued.	123
Dendrograptus divergens J. Hall	25, 37, 134
flexilis T. S. Hall non J. Hall, syn. of D. flexuosus J. Hall	25 (cf.), 37
Dicellograptus affinis T. S. Hall	46, 47 (desc.), 51, 53, 75, 84, 89 (cf.), 102, 126
anceps Nich.	30, 37, 40, 46 (cf.), 84, 86 (cf.), 157, 159
caduceus Lapw.	46 (cf.), 75, 86 (cf.), 89 (cf.), 126 (cf.), 159
complanatus Lapw.	90, 96 (cf.), 126 (cf.), 134, 135, 150 (cf.), 157 (cf.), 159

Species and Synonyms	*Reference in Bibliography*
var. ornatus Elles & W.	53, 84, 86, 102 (?), 126 (cf.), 159
didymus Thomas & K. M.S.	126
divaricatus J. Hall	47 (cf.), 126, 134, 157, 159
var. rigidus Lapw.	150
var. salopiensis Elles & W.	126, 157, 159
elegans Carr.	30, 37, 40, 46, 47 (cf.), 52, 53, 57, 63, 75, 84, 90, 96, 102, 123, 126, 134, 135, 150, 157, 159
var. rigens Lapw.	126
extensus J. Hall, cf. Didymograptus extensus	34
forchammeri Geinitz	53 (cf.), 84 (aff.), 123 (cf.), 126, 159
var. flexuosus Lapw.	123, 126
furcatus J. Hall, syn. of Dicranograptus furcatus	
(?) gracilis (doubtful reference)	75
gravis Keble & H.	102 (desc.), 114 (cf.), 120
gurleyi Lapw.	70, 84, 114 (cf.)
havelockensis Thomas & K. M.S.	126
intortus Lapw.	126, 157
latusculus Thomas & K. M.S.	126
moffatensis Carr.	126, 150 (cf.)
morrisi Hopk.	31, 37, 40, 46 (cf.), 70, 84
pumilus Lapw.	102 (?), 126, 150 (cf.), 159
ramosus, *vide* Dicranograptus ramosus	
sextans J. Hall	30 (?), 37, 38, 40, 84, 86, 90, 123, 126, 134, 135, 138, 150 (cf.), 157, 159
smithi Rued.	90 (cf.), 150 (cf.)
Dichograptus kjerulfi Herrmann, syn. of Goniograptus thureaui et G. macer	40
latus Eth. cf. Didymograptus latus	
octobrachiatus J. Hall	6, 8, 11, 14, 19, 22, 25, 28, 37, 40, 53, 56, 57, 59, 61, 70, 75, 81, 87, 90, 95, 101, 117, 120, 127, 138, 145, 157
octonarius J. Hall	25, 40, 77, 81
sedecimus Harris & T.	155 (desc.)
Dicranograptus brevicaulis Elles & W.	126, 134, 135, 138, 157
clingani Carr.	157, 159
cyathiformis Elles & W.	63 (cf.)
furcatus J. Hall	6, 8, 16, 19, 22, 34, 37, 57, 84, 90 (?), 102, 123 (cf.), 126 (cf.)
var. minimus Lapw.	114, 126
hians T. S. Hall	52 (desc.), 53, 70, 82, 84, 86, 102, 123, 134, 135, 157, 159
var. apertus T. S. Hall	62 (desc.), 159
nicholsoni Hopk.	52, 53, 57, 63, 84, 90, 102, 123, 126, 134, 135, 157

Species and Synonyms	*Reference in Bibliography*
ramosus J. Hall	6, 8, 11, 13, 16, 19, 22, 30, 37, 40, 56 (cf.), 57, 86, 90, 102, 112, 126
var. longicaulis Elles & W.	57, 84, 126
var. semispinifer T. S. Hall	53 (desc.), 56, 84, 86
var. spinifer Lapw.	123, 126, 157
rectus Hopk.	111
zic-zac Lapw.	126 (cf.), 127 (?), 135, 157
var. minimus Lapw.	47, 90, 134
Dictyonema campanulatum Harris & K.	109 (desc.), 134, 135, 157
delicatulum Lapw.	51 (cf.)
grande T. S. Hall, syn. of D. macgillvrayi	
macgillvrayi T. S. Hall	24 (desc.), 27, 31 (emend.), 37, 56, 69, 70, 87, 97, 120, 121, 134, 135, 149, 157
pulchellum T. S. Hall	39 (desc.), 40, 70 (cf.), 87, 97, 134, 135, 157
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adamantinus T. S. Hall	76 (desc.)
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caduceus Salter, syn. of Isograptus caduceus cf. I. gibberulus and Didymograptus gibberulus var. forcipiformis Rued, syn. of Isograptus forcipiformis	
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cuspidatus Rued.	134 (desc.), 135, 138, 155, 157
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deflexus Elles & W.	98
(?) denticulatus J. Hall	16, 19
dependulus Harris & K.	121 (desc.)
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euodus Lapw.	156 (cf.)
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fruticosus, *vide* Tetragraptus fruticosus	
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gibberulus *vide* Isograptus gibberulus	
headi J. Hall, *vide* Tetragraptus headi	
hemicyclus Harris	127 (desc.), 155
latens T. S. Hall, cf. decens	76 (desc.), 101, 131
latus T. S. Hall	57 (desc.), 81, 87, 120, 131, 142, 155, 156, 157
var. aequalis Harris & T.	155 (desc.), 157
latus McCoy	6, 8, 13, 19, 155
mendicus Keble & H.	131 (desc.)
mundus T. S. Hall, cf. D. balticus	76 (desc.)
murchisoni T. S. Hall non Beck, syn. of D. protobifidus	32, 37, 40, 59, 61 (cf.), 70
nicholsoni Lapw.	61 (cf.), 78, 80, 138
nitidus J. Hall	11, 13, 19, 37, 46 (aff.), 59, 61, 77, 122, 138
nodosus Harris	105 (desc.), 120, 121, 129, 131, 134, 135, 138, 156, 157
ovatus T. S. Hall, syn. of Isograptus ovatus	
pantoni Eth., cf. Tetragraptus pantoni and T. fruticosus (2-branched)	13 (desc.), 19, 28, 53, 77
perditus T. S. Hall	76 (desc.), 149 (cf.)
pritchardi T. S. Hall	39 (desc.), 40, 51 (cf.), 56, 57, 70, 87, 97, 121, 134, 135, 155, 156 (cf.), 157
procumbens T. S. Hall	76 (desc.)
protobifidus Elles, cf. D. bifidus T. S. Hall non J. Hall	131, 134, 135, 138, 151, 157
serratulus J. Hall	6, 8, 16, 19, 37
similis J. Hall	90, 120, 121, 155, 157
suecicus Tull.	155 (cf.), 157 (cf.)
taylori T. S. Hall	39 (desc.), 87, 97, 121, 135, 167
thureaui, *vide* Goniograptus thureaui	
uniformis Elles & W.	90, 98, 121, 122 (cf.), 138

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v-fractus Salter	28, 98, 138
vicinus Harris & T.	155 (desc.)
Diplograptus aculeatus (Lapw.)	53 (cf.), 84 (cf.)
(Amplexograptus) arctus Elles & W.	123 (cf.)
angustifolius J. Hall	19, 37, 70, 81 (cf.), 84, 90 (cf.)
(Glyptograptus) austrodentatus Harris & K., cf. D. inutilis	121 (desc.), 122, 123, 129, 134, 135, 137, 138, 157
(Orthograptus) bellulus Torn.	42, 126 (cf.)
(O.) calcaratus Lapw.	57, 70, 84, 126, 135, 150, 159
var. acutus Lapw.	126, 157
var. basilicus Lapw.	126, 150
var. priscus Elles & W.	126
var. tenuicornis Elles & W.	143, 159
var. vulgatus Lapw.	102, 114, 126, 157
(O.) carnei T. S. Hall, syn. of D. (O.) truncatus	53, 63, 84, 102, 119
(Amplexograptus) coelatus Lapw., cf. D. (M.) decoratus	105, 131 (cf.), 134, 145, 156
(A.) confertus Lapw.	127, 134, 138, 145, 157
(Mesograptus) decoratus Harris & T.	134 (desc.), 135, 138, 156, 157
(Amplexograptus) differtus Harris & T.	134 (desc.), 138, 157
(Glyptograptus) dentatus Brongn.	121, 126, 134
(G.) euglyphus Lapw.	123, 126, 131, 135, 156, 157
var. sepositus Keble & H.	131 (desc.), 134 (cf.)
(Mesograptus) foliaceus auct. non. Murch.	14, 30, 31, 37, 38, 40, 46, 47, 51, 53, 56 (cf.), 63, 75, 84, 90, 96, 126
gnomonicus Harris & K., syn. of Skiagraptus gnomonicus	81 (desc.), 98, 119, 120
(Mesograptus) ingens T. S. Hall	53 (desc.), 56, 84, 102, 114, 126, 157
(Orthograptus) insectiformis, var. vagus Thomas & K. M.S.	126
(Glyptograptus) intersitus Harris & T.	134 (desc.), 135, 156, 157
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(Mesograptus) linearis T. S. Hall	86
(M.) magnus Lapw.	126
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(Mesograptus) modestus Lapw.	42, 126
(Amplexograptus) modicellus Harris &. T.	134 (desc.), 135

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(Mesograptus) multidens Elles & W.	126, 134, 135, 157
var. nov. Thomas & K. M.S.	126
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nodosus Harkness, cf. Monograptus lobiferus	37, 40
(Orthograptus) pageanus Lapw.	126 (cf.), 157
(Petalograptus) palmeus J. Hall	11, 16, 19, 22, 34 (cf.), 37, 47, 90, 96
(Amplexograptus) perexcavatus Lapw.	117, 120, 131 (cf.), 157
(Orthograptus) pristis His.	6, 8, 11, 13, 14, 16, 19, 22, 30, 37, 40, 46, 84, 90
quadrangularis McCoy, syn. of Climacograptus riddellensis	6, 8, 11, 13, 19, 22
(Orthograptus) quadrimucronatus J. Hall	53, 62, 84, 102, 126, 134, 135, 143, 157, 159
var. spinigerus Lapw.	126
rectangularis McCoy, syn. of Climacograptus riddellensis	47, 98
(Glyptograptus) sinuatus Nich.	42, 126, 154, 157
(G.) tamariscus Nich.	51 (cf.), 84 (cf.), 126, 134, 135, 157
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(Glyptograptus) teretiusculus Nich.	126, 127, 134, 135, 137, 138, 156, 157
var. siccatus Elles & W.	126, 134
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(Orthograptus) truncatus Lapw.	30, 37, 40, 46, 47, 53, 84, 102, 123, 131, 135, 138, 157, 159
var. abbreviatus Elles & W.	126
var. intermedius Elles & W.	102, 123, 126
var. pauperatus Elles & W.	123, 126, 157
var. socialis Lapw.	126
(O.) whitfieldi J. Hall	47 (cf.)
Gladiolites australis McCoy, syn. of Stomatograptus australis	
Glossograptus acanthus Elles & W.	126 (cf.), 135, 138, 145, 156 (cf.), 157
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mucronatus J. Hall, cf. Diplograptus mucronatus	37, 47, 90 (?), 96
pilosus Keble & H.	126, 134 (desc.)
quadrimucronatus, syn. of Diplograptus quadrimucronatus	62
Goniograptus crinitus T. S. Hall	76 (desc.), 81, 90, 98, 120, 121
laxus T. S. Hall, syn. of Sigmagraptus laxus	76 (desc.), 101, 120
logani Eth. cf. Loganograptus logani	
macer T. S. Hall	40 (desc.), 46, 59, 61, 70, 76, 77, 81, 87, 90, 117, 120, 121
palmatus Harris & K.	121 (desc.), 149 (aff.)
speciosus T. S. Hall	76 (desc.), 81, 90, 120, 121, 122
thureaui McCoy	17, 18 (desc.), 22, 25, 28, 37, 40, 44, 57, 59, 61, 68, 69, 70, 77, 81, 87, 90, 98, 112, 120, 121, 134, 135
Isograptus caduceus (Salter), cf. I. gibberulus, Didymograptus caduceus, D. gibberulus	6, 11, 15, 19, 22, 25, 28, 29, 30, 32, 34 (cf.), 37, 40, 46 (?), 53, 56, 58, 59, 61, 70, 77, 78, 80, 81, 84, 90, 95, 96, 98, 104, 105, 117, 120, 121, 122, 126, 127, 134, 138, 145, 156, 157
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var. imitata Harris	16 (cf.), 127 (desc.)
var. lunata Harris	127 (desc.), 129, 134, 138, 157
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ovatus (T. S. Hall)	46 (desc.), 84, 98, 123, 126, 127, 131, 138, 156
Lasiograptus (Thysanograptus) etheridgei Harris, cf. Diplograptus mucronatus	90 (?), 96, 98 (desc.), 134, 135, 138, 156, 157
(Neurograptus) fibratus Lapw.	86 (cf.)
(N.) margaritatus Lapw.	59, 84, 157
(Hallograptus) mucronatus J. Hall, cf. Diplograptus mucronatus	156 (cf.), 157
(H.) proteus Harris & T.	134 (desc.), 135, 138, 157
Leptograptus antiquus T. S. Hall, syn. of Bryograptus antiquus	
capillaris Carr.	102, 126, 159 (cf.)
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var. subjectus Keble & H.	102 (desc.), 126
validus Lapw.	126 (cf.)
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concinnus Lapw.	66 (?), 71 (cf.), 107 (cf.), 136 (cf.)
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crenulatus Torn.	57, 71, 99 (cf.), 104, 107 (cf.), 136 (cf.)
crinitus Wood	154
crispus Lapw.	107, 136 (cf.)
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decipiens Torn.	143 (cf.), 159 (cf.)
dubius (Suess)	40 (cf.), 45 (cf.), 53, 57 (cf.), 71 (cf.), 99 (?), 104, 107, 118, 126, 131 (cf.), 136 (cf.), 154
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galaensis Lapw.	37 (cf.), 126, 139, 154
gregarius Lapw.	126
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jaekeli Perner	99 (cf.)
leptotheca Lapw.	101, 107
lobiferus McCoy	36, 40
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marri Perner.	126
mcCoyi Lapw.	101, 107 (cf.)
melbournensis Thomas & K. M.S.	126
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nudus Lapw.	154 (?)
pandus Lapw.	126, 131
priodon Bronn, cf. M. ludensis Murch.	19, 37, 40, 71, 76, 107, 118, 126, 136, 154
proetus Barr.	101 (cf.)
riccartonensis Lapw.	71, 107, 111, 118, 128, 136, 139, 154
romeri Barr	107, 126
runcinatus Lapw.	153
scanicus Tull.	131
sedgwicki Portlock.	126, 136
spiralis Geinitz	159
var. permensis Keble & H.	126, 131 (desc.), 154
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tumescens Wood	150 (cf.)
turriculatus Barr.	76, 107, 118, 131, 136
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var. orbatus Wood	139, 154
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undulatus Elles & W.	143, 159
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var. crenulatus (Torn.)	154
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Pterograptus incertus Harris & T.	134 (desc.), 138, 157
lyricus Keble & H.	131 (desc.), 138
Ptilograptus plumosus J. Hall	51 (cf.)
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pulcherrimus Keble & H.	126, 131 (desc.), 134, 135, 157, 159
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caudatus, syn. of R. (P.) nebula	47 (desc.), 53
(Plegmatograptus) nebula Elles & W.	47 (desc.), 53, 119
Schizograptus incompositus Harris & T.	155 (desc.), 157
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Sigmagraptus laxus (T. S. Hall)	76, 101, 120, 121, 131, 142
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Staurograptus diffissus Harris & K.	109 (desc.), 120, 121, 134, 135, 157
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Temnograptus magnificus Pritchard, syn. of Clonograptus magnificus	
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clarkei Rued.	77, 88
clarkfieldi Thomas & K. M.S.	126, 157
decipiens T. S. Hall	11 (cf.), 39 (desc.), 40, 56, 57, 59, 69, 70, 87, 91, 92, 97, 101, 119, 120, 121, 123, 129, 130, 131, 134, 135, 137, 149, 156 (cf.), 157
var. bipatens, Keble & H.	131 (desc.)
defensus Harris & T.	134 (desc.)
denticulatus J. Hall	37
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fruticosus (3-branched), J. Hall ..	13, 14, 51, 53, 56, 61, 70, 77, 81, 93, 101, 120, 121, 127, 130, 134, 135, 157
fruticosus (4-branched), J. Hall ..	14, 16, 51, 53, 70, 77, 81, 90, 93, 101, 120, 121, 130, 131, 134, 135, 156, 157
harti T. S. Hall	76 (desc.), 87, 101, 121, 149 (cf.), 155
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quadribrachiatus J. Hall	6, 8, 11, 13, 14, 19, 22, 25, 27, 28, 32, 37, 40, 51, 53, 56 (cf.), 57, 59, 61, 68, 69, 70, 77, 81, 87, 90,

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similis (J. Hall) cf. T. bigsbyi	77, 81, 87, 120, 121, 127, 131
tabidus Keble & B.	108 (cf.), 126 (cf.)
triograptoides Harris & T.	155 (desc.)
vestrogothus Torn.	157
volitans Harris & T.	155 (desc.)
whitelawi T. S. Hall	76 (desc.)
Thallograptus succulentus (Rued.)	147 (cf.)
Thamnograptus capillaris Emmons.	98, 127 (cf.)
typus J. Hall	25, 37, 98
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immotus Harris & T.	134 (desc.), 157
Trigonograptus ensiformis J. Hall	40, 90, 98, 105, 120, 121, 127, 134 (cf.), 137, 138, 145, 156, 157
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Trochograptus australis Harris & T.	154 (desc.)
diffusus Holm.	154 (cf.)
indignus Harris & T.	154 (desc.)

Hydroida.

Some hydroid genera of uncertain systematic relationship, such as *Mastigograptus* and *Chaunograptus,* have been regarded as primitive graptoloids or dendroids. Bulman (158) points out that "some of the Acanthograptoids and in particular the geologically early *A. priscus* recall in size and general appearance the Cambrian hydroids *Archaeolafoea* and *Archaeocryptolaria* of Chapman and Thomas (147), but in these there is at present no indication of polymorphism (such, indeed, would be of very different character if their relation to the Perisiphonidae is correctly assumed) and the resemblance is probably superficial only."

Chapman and Thomas (147), extending earlier studies (82) record from Cambrian shales and mudstones in Central Victoria the following hydroid forms which are referred by them to the calyptoblast families of Campanulariidae and Idiidae, though certain of the genera concerned have been classed by Ruedemann under the Dendroidea, in which *Ptilograptus* and *Thallograptus,* cited among the graptolites, have been retained there.

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Archaeocryptolaria flabelloides Chapman & T.	147
recta Chapman	82, 85, 147
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skeatsi Chapman	82, 85, 147
Archaeolafoea longicornis Chapman	82, 85, 147
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serialis Chapman & T.	147
Cactograptus crassus Rued.	147
flexispinosus Chapman & T.	147
plumigerus Chapman & T.	147
Chaunograptus gemmatus Rued.	147
Mastigograptus arundinaceus (J. Hall)	147
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Locality Index.

This index gives the locality or district mentioned by the author of the paper, the number of which in the Bibliography, appears opposite that locality. In most papers more precise details are given.

Localities outside Victoria are indicated by the initial letters of the State in which they are.

The following abbreviations are used:

Co. . . . County	R. . . . River
Ck. . . . Creek	Rd. . . . Road
Mt. . . . Mount	Rf. . . . Reef.
N.S.W. . . . New South Wales	Rly. . . . Railway
Par. . . . Parish	T. . . . Tasmania
Q. . . . Queensland	

Symbols after some localities (thus, Ba 78) are those used on the Geological Quarter Sheets of the area to fix fossil localities; e.g., Ba 78 refers to a locality in Barker Street, Castlemaine, so shown on Quarter Sheet of the Castlemaine area.

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THE FRESHWATER MOLLUSCA OF VICTORIA.

By C. J. Gabriel.

(Honorary Conchologist, National Museum.)

(Plates I-IV, Figs. 1-43.)

In the Journal of the Linnean Society of London, Vol. xvi, 1882, E. A. Smith published a well illustrated article on The Freshwater Shells of Australia. Since then, however, in this State the fluviatile forms have been somewhat neglected. Confusion prevails as regards both genera and species, and the present paper has been prepared with the object of assisting in identification of the Victorian species. Much has been written on the subject, but as W. L. May remarks in his Revised Census of the Tasmanian Fluviatile Mollusca (Pr. Roy. Soc. Tas. for 1920, p. 65), "overlapping has occurred in previous work, creating many synonyms through the absence of figures and uncertainty as to what previously described species really were. Again, too much stress has been laid on small variation in the erection of species, which variation proves to be individual and not specific." This applies to many Victorian forms, a fact made evident in the large synonymy.

Thirty-three species are herein accepted and are represented as follows: *Melania* 1, *Vivipara* 1, *Bythinella* 3, *Limnaea* 4, *Myxas* 1, *Ameria* 4, *Isidorella* 2, *Planorbis* 3, *Segmentina* 1, *Ancylus* 2, *Gundlachia* 1, *Corbicula* 1, *Sphaerium* 2, *Pisidium* 1, *Hyridella* 2, *Propehyridella* 3, *Protohyridella* 1, together with varieties in *Ameria* (7) and *Isidorella* (3). In comparison with other States, Victoria has few species, but I consider that when our lagoons, rivers and lakes are thoroughly explored additional species will be found.

Through the courtesy of the Director of the National Museum, I have had the Museum collection at my disposal, together with the collections of the late W. Kershaw, T. Worcester, J. H. Young, F. L. Billinghurst, and several others.

Earliest in the field were the French naturalists, Quoy and Gaimard, who, under the name of *Paludina buccinoides,* described and figured one of our smallest species (now known as *Bythinella buccinoides*) collected as dead shells in brackish swamps at Westernport. This mollusc is abundant

throughout the State, but so much misunderstood that I have thought it advisable to reproduce the original description on a later page, together with that of *B. nigra* Q. and G.

In the Transactions of the Royal Society of South Australia, 1882, p. 76, Professor Tate, in a List of Victorian Freshwater Pulmoniferous Snails, includes *Limnaea viridula* Tate, from Murndal, Hamilton, and Dr. Cherry, Proc. Roy. Soc. Vict., 1896, p. 183, identifies a form from the headwaters of the Wimmera as *Limnaea venustula*. After careful search I have failed to locate descriptions of these species and suggest that they are manuscript names only.

Perhaps the most perplexing Victorian freshwater molluscs are the species now referred to the genera *Ameria* and *Isidorella,* but formerly placed under *Physa, Bullinus, Isidora,* and *Amplexa* by various authors. Of recent years these freshwater snails have attracted attention as intermediate hosts for sheep fluke and possible hosts of *Bilharzia.* Hedley, in his Notes on the Victorian Species of *Bullinus* (Rec. Aust. Mus., 1917, p. 1) writes: "This group presents the student with exceptional difficulties. The species appear to vary extremely and to limits not yet ascertained. With the honourable exception of Tate's Essay in the Zoology of the Horn Expedition, the literature has multiplied names and ignored variation. A chance handful from any pool is likely to present individuals with a longer and a shorter spire. The first lesson to be learnt in studying this group is how changeable a character is this elevation of the spire. The presence or absence, spacing or punctuation, of spiral sculpture, can not be used as a safe guide to specific differentiation. These features are the imprint of spiral threads or lines of cilia in the epidermis. But the epidermal coat varies in development according to local conditions, so that lines of cilia, which would apparently be otherwise developed, seem to be repressed in unfavourable environment. Yet some geographical series suggest that there are species which never develop such ciliae. A more abundant supply of lime allows a deposit on the inner lip and hence longitudinal streaks that mark previous rest stages."

Although Hedley adds that no positive conclusions are advanced, his article considerably clarifies the nomenclature of these puzzling forms.

In regard to distribution, haphazard dispersal is effected in many ways; some molluscs are transported by water-plants, others by animals, and by these means newly formed ponds and creeks are populated. B. C. Cotton gives an interesting

account in the South Australian *Naturalist,* 1934, No. 4, p. 113, of a fine specimen of *Hyridella australis* found attached to the foot of a Black Duck, *Anas superciliosa,* shot on the wing near Narracoorte, South Australia.

Pearls are occasionally found in our freshwater mussels.

The types of the two new species herein described and also all specimens illustrated are now in the National Museum of Victoria, with the exception of those shown in figs. 9, 16, 19 and 20.

I am indebted to Mr. C. W. Brazenor of the National Museum for the excellent photographs used to illustrate this paper.

GASTROPODA.

Family **MELANIIDAE.**

Genus MELANIA Lamarck, 1799.

Melania balonnensis Conrad.

(Pl. I, Fig. 1.)

1843 Melania lirata Menke (non Benson), Moll. Nov. Holl, p. 9.
1850 M. balonnensis Conrad, Pr. Acad. Nat. Sci. Phil., v, p. 11.
1850 M. tetrica Conrad, op. cit.
1866 Id., Conrad, Am. Journ. Conch., ii, p. 80, pl. 1, fig. 9.
1866 M. balonnensis Conrad, op. cit., ii, p. 80, pl. 1, fig. 10.
1874 Id., Brot, Conch. Cab., i, Abth. 24, p. 287, pl. 28, figs. 14, a, b,; 15.
1878 M. oncoides Tenison Woods, Pr. Linn. Soc. N.S.W., iii, p. 5.
1882 M. tatei Brazier, n.n. for tetrica Conrad (non Gould), Pr. Linn. Soc. N.S.W., vi, p. 551.
1882 M. Balonnensis Conrad. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 560.
1882 Id., Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 257, pl. 5, figs. 1-3.
1882 M. subsimilis Smith, op. cit., p. 262, pl. 5, fig. 13.
1896 M. balonnensis Conrad. Tate, Horn. Exp. Zool., ii, p. 209.
1896 M. tetrica Conrad. Tate, op. cit.
1897. M. subsimilis Smith. Tate, Tr. Roy. Soc. S. Aust., p. 43.

Size.—Length, 25 mm.; breadth 11 mm.

Localities.—Murray River (J. A. Kershaw); Gayfield, Bannerton (A. C. Nilson); Ned's Corner (F. A. Cudmore).

Vernacular Name.—The Balonne River Melania.

Observations.—In this species, as in other members of the genus, the apex, which is perfect in the juveniles, is usually eroded or truncate in larger specimens. Smith notes its wide distribution in Australia and remarks: "The colour, as well as the sculpture, is subject to considerable variation. Some specimens are uniformly olivaceus, whilst others are closely spotted with small streaks and minute dots of a dark red, the latter being pretty constantly upon the spiral raised ridges.

Two or three of the latter, around the middle of the whorls of the spire and at the upper part of the last volution, become more or less tubercular on crossing the plicae."

Family **VIVIPARIDAE.**

Genus VIVIPARA Lamarck, 1809.

Vivipara hanleyi (Frauenfeld).

(Pl. I, Fig. 2.)

1862 Paludina hanleyi Frauenfeld, Verhandl. Zool. Bot. Ges. Wein., xii, p. 612.
1864 P. intermedia Hanley. Reeve, Conch. Icon., xiv, pl. 9, fig. 57.
1865 P. purpurea Martens, Ann. Mag. Nat. Hist., 3 ser., xvi, p. 428.
1882 P. Hanleyi Frauen. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 561.
1882 Vivipara intermedia Hanley. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 264.
1935 Notopala hanleyi Frauen. Cotton, Rec. S. Aust. Mus., v, no. 3, p. 339, figs. 17, 18 (in text).
1935 Id., Cotton, Vict. Nat., lii, no. 6, p. 96, fig. 1 (in text).

Size.—Length, 25 mm.; breadth, 20 mm.

Localities.—Murray R. (Blandowski Coll., Nat. Mus., Melb.); Chalka Creek (A. S. Kenyon); Irymple (J. H. Young); Bannerton (A. C. Nilson); Swan Hill.

Vernacular name.—Hanley's River Snail.

Observations.—A solid, globose shell with a tendency to angulation towards the base. The periostracum is dark green to brownish and the operculum is horny and concentric. Smith, commenting on the genus *Vivipara,* remarks: "Two peculiarities are constant in all the Australian species of the genus. Every example that has come under my examination exhibits spiral sculpture; and in none of them are colour-bands found below the periphery."

V. hanleyi is no exception, the sculpture consisting of microscopic, granose lirae on the whole of the outer surface. For the reception of the Australian species exhibiting this character, Cotton erected the genus *Notopala.* This type of sculpture, however, is not confined to Australian forms; for instance, the North American *V. angulata* Lea and *V. decesa* Say have similar sculpture. Whilst retaining *Vivipara,* I think Cotton's genus could be used subgenerically.

The animal, which is ovoviparous, lives in mud below low-water mark, in freshwater rivers and lakes. It is common in the Lower Murray, where the shells are often found on sites of native camps.

V. hanleyi (Frauenfeld) is the genotype of *Notopala.*

Family **HYDROBIIDAE.**

Genus BYTHINELLA Moquin-Tandon, 1851.

Bythinella nigra (Quoy and Gaimard).

(Pl. I, Figs. 3, 3a.)

1835 Paludina nigra Q. and G., Zool. Astrolabe, iii, p. 174, pl. 58, figs. 9-12.
1871 Paludestrina legrandiana Brazier, P. Z. S. Lond., p. 678.
1871 P. wisemaniana Brazier, op. cit., p. 679.
1875 Bithinia petterdiana Brazier, Pr. Linn. Soc. N.S.W., i, p. 19.
1876 B. legrandi Tenison Woods, Pr. Roy. Soc. Tas., p. 76.
1876 B. unicarinata Ten. Woods, op. cit., p. 77.
1876 B. tasmanica Ten. Woods, op. cit., p. 77.
1879 Bythinella exigua Ten. Woods, op. cit., p. 71, n.n. for legrandi Ten. Woods.
1882 Bithyinella nigra Q. and G. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 564.
1889 Potamopyrgus nigra Q. and G. Petterd, Pr. Roy. Soc. Tas., p. 69, pl. 3, figs. 2-8.
1893 P. niger Q. and G. Tate, Tr. Roy. Soc. S. Aust., xvii, p. 200.
1920 Bithinia legrandiana Brazier. May, Pr. Roy. Soc. Tas., p. 72, pl. 11, fig. 23.
1920 B. legrandi Ten. Woods. May, op. cit., p. 72, pl. 11, fig. 24.
1920 B. unicarinata Ten. Woods. May, op. cit., p. 72, pl. 11, fig. 25.
1920 B. tasmanica Ten. Woods. May, op. cit., p. 72, pl. 11, fig. 26.
1920 B. exigua Ten. Woods. May, op. cit., p. 72.
1921 Potamopyrgus nigra Q. and G. May, Check-List Moll. Tas., p. 56, No. 501.
1923 Id., May, Ill. Index Tas. Shells, pl. 26, fig. 3.

Size.—Length, 4·5 mm.; breadth, 2·25 mm.

Localities.—Mordialloc (Nat. Mus., Melb.); Echuca (J. A. Kershaw); Dromana (T. Worcester); Tanti Creek, Mornington (Rev. G. Cox); Koroit (W. Paterson); Hall's Gap (C. Oke); Ballarat (J. H. Young); Lake Connewarre (F. S. Colliver); Reservoir, Studley Park (C. J. Gabriel).

Vernacular Name.—The Black Bythinella.

Observations.—This is the largest species of the genus in Victoria; it is plentiful and widely distributed throughout the State. The type locality is small freshwater creeks, D'Entrecasteaux Channel, Tasmania. Quoy and Gaimard's original description is as follows: *"Paludina, testa minima, ovato-turrita, nigra; anfractibus quarternis obliquis, convexis; spira obtusa; apertura subcirculari, prominente"*—the authors noting operculum membranous with concentric lines. That this has proved a much misunderstood species is evidenced in the large and confusing synonymy. As Petterd remarks: "In size, with the relative length of spire and aperture, it varies almost indefinitely, so much so that almost

every little stream or pool has its own special variety, so that it is quite impossible and certainly unnecessary to enumerate all the modifications. In many localities the whorls are more or less sharply carinated, with sometimes the additional ornamentation of a line of interrupted pointed spines, but plain, carinated and spinose specimens are often found living in the same pool. The same peculiarity has been noticed in one or two of the New Zealand forms of the genus. In clear running streams, the shells are often substranslucent and of a pale yellowish horn colour, but in quiet still water they are usually coated with a thick covering of decaying vegetable matter, generally of a rusty brown colour."

Petterd's remarks apply equally to Victorian forms, many specimens showing variation towards the varieties *legrandiana* Brazier and *unicarinata* Ten. Woods. W. L. May adopts this synonymy, and I agree with the conclusions of these Tasmanian workers.

Bythinella buccinoides (Quoy and Gaimard).
(Pl. I, Fig. 4.)

1835 Paludina buccinoides Q. and G., Zool. Astrolabe, iii, p. 175, pl. 58, figs. 13, 14.
1858 Hydrobia tasmanica Von Martens, Weig. Arch. Nat. Sci., i, p. 185, pl. 5, fig. 12.
1865 Amnicola diemense Frauenfeld, Verhandl. Zool. Bot. Ges. Wien, xv, p. 529, pl. 10, 2 figs.
1875 Bythinia dulvertonensis Ten. Woods, Pr. Roy. Soc. Tas., p. 77.
1878 Bithinia victoriae Ten. Woods, Pr. Roy. Soc. Vict., xiv, p. 65.
1878 Bythinella victoriae Ten. Woods, Pr. Roy. Soc. Tas., p. 71.
1882 Bithynia Dulvertonensis Ten. Woods. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 563.
1882 Hydrobia buccinoides Q. and G. Smith, Journ, Linn. Soc. Lond., Zool., xvi, p. 269.
1882 H. victoriae Ten. Woods. Smith, op. cit., p. 270, pl. 7, fig. 20.
1882 H. Angasi Smith, op. cit., p. 271, pl. 7, fig. 22.
1888 Potamopyrgus woodsi Petterd, Pr. Roy. Soc. Tas., p. 71, pl. 1, fig. 12.
1889 Amnicola diemense Frauen. Petterd, Pr. Roy. Soc. Tas., p. 81.
1913 Littoridina diemensis Frauen. Hedley, Pr. Linn. Soc. N.S.W., xxxviii, Pt. 2, p. 284, pl. 17, fig. 52.
1914 Bythinella nigra Q. and G. Chapman, Mem. Nat. Mus. Melb., No. 5, p. 57.
1917 Id., Chapman and Gabriel, Pr. Roy. Soc. Vict., xxx (n.s.), Pt. 1, p. 9.
1920 Potamopyrgus woodsi Petterd. May, Pr. Roy. Soc. Tas., p. 73, pl. 12, fig. 29.
1920 Bythinia dulvertonensis Ten. Woods. May, Pr. Roy. Soc., Tas., p. 72, pl. 12, fig. 28.
1921 Potamopyrgus tasmanica Von Martens. May, Check-list Moll. Tas., p. 56, No. 503.
1923 Id., May, Ill. Index Tas. Shells, pl. 26, fig. 4.

Size.—Length, 2·5 mm.; breadth, 1·5 mm.

Localities.—Western Port (Type); Gippsland (Nat. Mus. Melb.); Merri Creek (W. Kershaw); Lake Connewarre (F. S. Colliver); Werribee R. (R. Hall); Queenscliff (J. A. Kershaw); Lake Gnotuk (J. Searle); Geelong (J. Mulder); Port Albert, Lakes Entrance, Longford, Tarraville, Dromana, Frankston (T. Worcester); Moorabool R. (J. H. Young); Colac (Rev. G. Cox); Portland (W. H. Dillon); Merri Creek, Coburg (Mrs. W. Hanks); Merri R., Warrnambool.

Vernacular Name.—The Whelk-like Bythinella.

Observations.—An extremely variable species, approaching *B. nigra,* but distinguished by its shorter spire, more inflated whorls and a rounder mouth. The following is Quoy and Gaimard's original description: *"Paludina, testa minima ovato-conica, apice subacuta; lacvi, flavescente, vitta fulva bicincta; anfractibus senis, convexis; apertura ovali";* the authors remarking that all specimens were dead shells collected in brackish swamps at Westernport. Smith, under the name of *Hydrobia angasi,* described a form from the Compasely River (Campaspe), which I consider is merely a variant of *buccinoides,* slightly broader in contour, but otherwise inseparable. This form has been noted from several districts throughout the State. Specimens of *Bythinella* from a shell-bed underlying volcanic tuff near Warrnambool were determined by Chapman and Gabriel as *nigra* Q. and G.; but re-examination of this material forces us to change our opinion and to accept *buccinoides* Q. and G., as the correct nomination. In several localities specimens are more or less carinated, but less so than *B. nigra.* Like *nigra, buccinoides* is frequently coated with decaying vegetable matter.

Bythinella grampianensis sp. nov.

(Pl. I, Fig. 5.)

Shell minute, turbinately elongate; whorls about $4\frac{1}{2}$, much rounded, sutures well impressed. Aperture small, pyriform, continuous, inner lip reflected; colour brown.

Size of Type.—Length, 2 mm.; breadth, 1 mm.

Locality.—Dairy Creek, near Silver-Band Falls, Grampians. Collected by F. E. Wilson.

Vernacular Name.—The Grampians Bythinella.

Observations.—A very small species with much rounded whorls. Its nearest ally is perhaps the Tasmanian *Hydrobia*

gunni Frauen., from which it may be distinguished by its smaller size and more turbinate form.

Type in the National Museum, Melbourne. Reg. No. 71209.

Family **LIMNAEIDAE.**

Genus LIMNAEA Lamarck, 1799.

Limnaea lessoni Deshayes.

(Pl. I, Fig. 6.)

1830 Limnea lessoni Desh., Magasin de Zool., p. 16, figs. 1, 2.
1830 Lymnaea lessonii Desh. Lesson, Voy. Coquille, Zool., p. 330, pl. 15, fig. 1.
1830 Lymnaea lessonii Desh. Lesson, Centurie Zoologique, p. 120, pl. 44 (shell and animal).
1850 Lymnea perlevis Conrad, Pr. Acad. Nat. Sci. Phil., v, p. 11.
1854 Amphipeplea strangei Pfiffer, Malak. Blatt., p. 64.
1854 Id., Novit. Conch., p. 6, pl. 2, figs. 5, 6.
1854 Amphipeplea melbournensis Pfeiffer, op. cit., p. 70, pl. 19, figs. 14, 15.
1859 Limnaea (Neristoma) lessoni, Desh. Chenu. Man. de Conch., i, p. 480, fig. 3542.
1862 Limnea lessoni Desh. Küster, Conch. Cab., pl. 5, figs. 16, 17.
1866 Amphipeplea perlevis Conrad, Am. Journ. Conch., ii, p. 80, pl. 1, fig. 5.
1873 Limnaea melbournensis Pfr. Reeve, Conch. Icon., xviii, pl. 6, fig. 39.
1873 L. strangei Pfr. Sowerby, Conch. Icon., xviii, pl. 6, fig. 40.
1873 L. globosa Sby. Reeve, Conch. Icon., xviii, pl. 12, fig. 84.
1882 Lymnaea Lessoni Desh. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 554.
1882 Limnaea (Amphipeplea?) Lessoni Desh. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 271.
1882 L. melbournensis Pfr. Tate, Tr. Roy. Soc. S. Aust., iv, p. 76.
1894 L. lessoni Desh. Whan, Geelong. Nat., iv, No. 10, p. 9.
1896 Id. Fielder, Vict. Nat., xii, No. 11, p. 140.
1917 Id. Cherry, "Bilharziosis," p. 4, fig. 11.
1932 Id. Cotton and Godfrey, S. Aust. Nat., xiii, p. 158, pl. 2, fig. 3.

Size.—Length, 24 mm.; breadth, 18 mm.

Localities.—Melbourne (Nat. Mus. Melb.); South Brighton (W. Kershaw); Lake Koollamuth (Rev. Whan); Heidelberg (Rev. W. Fielder); Malvern (Rev. G. Cox); Sale (T. Worcester); Bannerton (A. C. Nilson); Shelford, Avoca (J. H. Young); Lake Hattah (J. E. Dixon).

Vernacular Name.—Lesson's Pond-Snail.

Observations.—A thin, globose, pale horn-coloured shell, the largest of the genus in Victoria; variable in shape, many examples having somewhat flattened sides, a feature in Conrad's *L. perlevis*. It is abundant and widely distributed throughout Victoria.

Limnaea subaquatilus Tate.

(Pl. I, Fig. 7.)

1880 Limnaea subaquatilus Tate, Tr. Roy. Soc. S. Aust., iii, p. 103, pl. 4, figs. 6a, 6b.
1881 Lymnaea subaquatilus Tate. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 555.
1882 Limnaea subaquatilus Tate. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 274.
1894 Amphipiplea subaquatilus Tate. Whan, Geelong Nat., iv, No. 10, p. 8.
1932 Limnaea subaquatilus Tate. Cotton and Godfrey, S. Aust. Nat., xiii, No. 4, p. 158, pl. 2, fig. 2.

Size of Type.—Length, 9 mm.; breadth, 3·75 mm.

Localities.—Stawell (F. L. Billinghurst); Geelong (J. Mulder).

Vernacular Name.—The Subaquatic Pond-Snail.

Observations.—An ovate, thin, shining, pale horn-coloured species allied to the Tasmanian *L. huonensis* Ten. Woods, but the last whorl is relatively narrower, and in consequence the revolution of the whorls is less oblique. The columella fold is thin, opaque white, and reflected.

Limnaea gunni Petterd.

(Pl. I, Fig. 8.)

1889 Limnaea Gunni Petterd, Pr. Roy. Soc. Tas., p. 66, pl. 2, fig. 10; pl. 3, figs. 9 and 12 (animal) .
1920 Id. May, Pr. Roy. Soc. Tas., p. 69.
1921 Id. May, Check-list Moll. Tas., p. 89.
1923 Id. May, Ill. Index Tas. Shells, pl. 41, fig. 8.

Size of Type.—Length, 7 mm.; breadth, 5·5 mm.

Locality.—Tarraville (T. Worcester).

Vernacular Name.—Gunn's Pond-Snail.

Observations.—A very thin, fragile, yellowish-horn coloured shell; the animal, as observed by the author, is pale bluish-white; its habitat is clear, gently-flowing water among submerged rocks, over which the mollusc smoothly glides without the jerky motion so characteristic of *L. subaquatilus* var. *neglecta* Petterd.

Limnaea victoriae Smith.

(Pl. I, Fig. 9.)

1882 Limnaea victoriae Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 274, pl. 5, fig. 16.

Size of Type.—Length, 6 mm.; diameter, 2 1-3 mm.

Localities.—Bairnsdale (Brit. Mus., from W. F. Petterd); Omeo (J. A. Kershaw, collected by A. W. Howitt).

Vernacular Name.—The Victorian Pond-Snail.

Observations.—In his description, Smith states that he has seen only two specimens, and remarks: "It is much narrower than *L. brazieri* or any of the Australian species of the genus. Of course it is impossible to say if either of these shells be adult; but, judging from the appearance of the columella and the callosity upon it, I am inclined to believe that such is the case."

Two specimens from Omeo in my cabinet confirm Smith's opinion that the shells described are adults and not the juvenile form of another species.

Genus MYXAS (Leach) J. Sowerby, 1822.

Myxas papyracea (Tate).

(Pl. I, Fig. 10.)

1880 Limnaea papyracea Tate, Tr. Roy. Soc. S. Aust., iii, p. 103, pl. 4, figs. 5a-5c.
1881 Lymnaea papyracea Tate. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 555.
1882 Limnaea papyracea Tate. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 274.
1893 Amphipeplea papyracea Tate. Billinghurst, Vict. Nat., x, p. 62.
1894 Amphipiplea papyracea Tate. Whan, Geelong Nat., iv., No. 10, p. 8.
1932 Myxas papyracea Tate. Cotton and Godfrey, S. Aust. Nat., xiii, No. 4, p. 159, pl. 2, fig. 1.
1936 Id. Cotton, S. Aust. Nat., xvii, Nos. 1-4, p. 83, fig. 39.

Size of Type.—Length, 12 mm.; breadth, 5 mm.

Localities.—Merrigum (J. F. Bailey); Daylesford (F. L. Billinghurst); Geelong (J. Mulder); Meredith (J. H. Young); Birregurra (A. C. Nilson).

Vernacular Name.—The Freshwater Paper Shell.

Observations.—An oblong-ovate, pale horn-coloured, very smooth and shining shell. The columella fold is slender; the inner lip widely and thinly spread. *Myxas* replaces the familiar *Amphipeplea,* for as Kennard and Woodward (Pr. Mal. Soc. Lond., xvi, 1924, p. 125) remark: "the true date of publication of S. Nilsson's *Historia Molluscorum Sveciæ* proving to be 1823 instead of 1822 (as stated on the title page (antea, p. 23)) causes his genus *Amphipeplea* to yield place on ground of priority to *Myxas* of Leach. Leach's name was given currency by J. Sowerby in his *Genera of Recent and Fossil Shells,* No. vii, published June 29, 1822 (article 'Limnea' (p. 3)), where 'Myxas, Leach's MS.' appears as

Section I of the genus Limnea, having as monotype *Helix glutinosa* Mont., which was also the monotype of Nilsson's genus."

Genus AMERIA H. Adams, 1861.

Ameria aliciae (Reeve).

(Pl. I, Fig. 11.)

1862 Physa (Ameria) aliciae Reeve, P. Z. S. Lond, p. 106, fig. in text.
1874 Id. Sowerby, Conch. Icon., xix, pl. 1, figs. 6a, b.
1878 Physa kershawi Ten. Woods, Tr. Roy. Soc. Vict., xiv, p. 64.
1881 Amplexa turrita Tate, Pr. Linn. Soc. N.S.W., vi, p. 409.
1882 Physa Aliciae Reeve. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 558.
1882 Physa Kershawi Ten. Woods. Tate and Brazier, op. cit.
1882 Physa turriculata Tate. Tate and Brazier, op. cit.
1882 Physa (Glyptophysa) aliciae Reeve. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 293.
1882 Physa Kershawi Ten. Woods. Smith, op. cit., p. 290.
1882 Aplexa turrita Tate, Tr. Roy. Soc. S. Aust., iv, p. 76.
1882 Aplexa kershawi Ten. Woods. Tate, op. cit.
1885 Physa aliciae Reeve. Clessin, Conch. Cab., i, Abth. 17, p. 298, pl. 43, figs. 2-5.
1885 Physa kershawi Ten. Woods. Clessin, op. cit.
1885 Physa cingulata Clessin, Conch. Cab., i, Abth. 17, p. 364, pl. 51, fig. 8.
1889 Physa aliciae Reeve. Cooke, P. Z. S., Lond., p. 140, figs. 5, 5a.
1893 Bulinus aliciae Reeve, var. cingulatus (Clessin). Billinghurst, Vict. Nat., x, p. 63.
1894 Bulinus aliciae Reeve. Whan, Geelong Nat., iv, No. 10, p. 8.
1917 Bullinus aliciae Reeve. Hedley, Rec. Aust. Mus., xii, No. 1, p. 5, pl. 1, fig. 14; pl. 2, figs. 17-18.
1932 Ameria aliciae Reeve. Cotton and Godfrey, S. Aust. Nat., xiii, No. 4, p. 161, pl. 2, fig. 11.
1936 Ameria aliciae Reeve. Cotton, S. Aust. Nat., xvii, Nos. 1-4, p. 83, fig. 38.

Size of Type.—18·75 mm.; breadth, 9·37 mm.

Localities.—Avoca, Meredith, Gunbower, Lal Lal Falls (Nat. Mus. Melb.); Lake Wendouree (R. Tate); Meredith (J. H. Young); Hamilton (T. Worcester); Mornington (Rev. G. Cox); Chalka Creek near R. Murray (R. McCaw); Castlemaine (F. L. Billinghurst).

Vernacular Name.—The Keeled Pond-Snail.

Observations.—A thin, spirally-ridged, whitish shell, covered with a pale dirty straw-coloured epidermis; whorls conspicuously angulate above. The number of ridges varies considerably, some examples showing mere traces. Its peculiar shape makes it the most readily recognized species of the genus in Victoria.

Ameria tenuistriata (Sowerby).

(Pl. I, Fig. 12.)

1874 Physa tenuistrata Sowerby, Conch. Icon., xix, pl. 10, fig. 85.
1874 P. texturata Sby., op. cit., pl. 12, fig. 95.
1882 P. tenuistriata Sby. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 556.
1882 P. texturata Sby. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 557.
1882 P. tenuistriata Sby. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 283.
1882 P. texturata Sby. Smith, op. cit., p. 283.
1886 P. tenuistriata Sby. Clessin, Conch. Cab., i, Abth. 17, p. 313, pl. 45, fig. 12.
1886 P. texturata Sby. Clessin, op. cit., p. 306, pl. 44, fig. 12.
1893 Bulinus tenuistriatus Sby. Billinghurst, Vict. Nat., x, No. 4, p. 63.
1896 Id. Barnard, Vict. Nat., xii, No. 10, p. 123.
1896 Isidora (Bulinus) texturata Sby. Fielder, Vict. Nat., xii, No. 11, p. 140.
1896 Isidora (Bulinus) tenuistriatus Sby. Fielder, op. cit.
1896 Physa tenuistriata Sby. Tate, Rept. Horn Exped., ii, Zool. p. 212.
1896 Physa texturata Sby. Tate, op. cit.
1917 Bulinus tenuistriatus Sby. Cherry, "Bilharziosis," p. 4, fig. 8.
1917 Bulinus texturatus Sby. Cherry, op. cit., p. 4, pl. 1, fig. 9.
1917 Bullinus tenuistriatus Sby. Hedley, Rec. Aust. Mus., xii, No. 1, p. 3, pl. 1, figs. 1, 2.
1917 Bullinus tenuistriatus Sby. var. texturatus (Sby.). Hedley, op. cit., figs. 3, 4.
1932 Ameria tenuistriata Sby. Cotton, S. Aust. Nat., xiii, No. 4, p. 160, pl. 2, fig. 6.
1936 Id. Cotton, op. cit., xvii, Nos. 1-4, p. 83.

Size of Average Specimen.—Length, 13 mm.; breadth, 9 mm.

Localities.—Heywood, Bunyip, Gunbower, Murtoa, Fernshaw, Kyneton (Coliban River), Botanic Gardens, Melbourne (Nat. Mus. Melb.); Swan Hill; St. Arnaud; Caulfield (F. L. Billinghurst); Colac (A. C. Nilson); Loddon River at Eddington (J. H. Young); Echuca; Heidelberg (F. G. A. Barnard); Lake Hattah (J. E. Dixon); Dartmoor (R. A. Keble); Overland Corner (F. H. Taylor). *Forma texturata* —Fern Tree Gully (Nat. Mus. Melb.); Dunolly (T. Worcester); Wimmera R. (Cox Coll.); Benalla (G. B. Pritchard); Stawell (F. L. Billinghurst); Mt. Alexander (R. Etheridge); Caulfield; N.E. Victoria (Rev. W. Fielder).

Vernacular Name.—The Thinly-Striated Pond Snail.

Observations.—Careful study of numerous specimens of the two forms described as *tenuistriata* and *texturata* from New South Wales, Victoria, and the type localities in South Australia leaves no doubt as to their specific identity. *Tex-*

turata merges so gradually into *tenuistriata* that they must be considered one species. As depicted in Hedley's excellent illustration, *texturata* is certainly a little more elongated, but the intermediates prevent its acceptance as a species. A typical specimen of *tenuistriata* from Overland Corner, Victoria, figured by Hedley is 13 mm. long and 9 mm. broad. He remarks: "the suture is margined beneath by a narrow pale line followed by a broader dark band. There is also a broad dark stripe within the outer lip. The sculpture consists of exceedingly delicate radial threads which may or may not be broken into short lengths by spiral striae." Of *Physa texturata,* Sowerby writes: "under a lens this appears as if impressed with a fine woven fabric"; does this not equally apply to *tenuistriata?*

In his paper on the Generic Position of the so-called Physae of Australia (P. Z. S. Lond., 1889, p. 136), Cooke, in a footnote, indicates that he considers the following synonymous: *proteus* Sby., *pyramidata* Sby., *dispar* Sby., *pectorosa* Conrad, *breviculmen* Smith, *badia* Ad. and Angas, *concinna* Ad. and Angas, *texturata* Sby.

Ameria tenuistriata (Sowerby) var. *pyramidata* (Sowerby).

(Pl. I, Fig. 13.)

1873 Physa pyramidata Sowerby. Reeve, Conch. Icon., xix, pl. 8, fig. 62.
1882 Id. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 557.
1882 Id. Smith, Journ. Linn. Soc. Lond., xvi, p. 282.
1886 Id. Clessin, Conch. Cab., i, Abth., 17, p. 243.
1920 Bullinus pyramidatus (Sby.). May, Pr. Roy. Soc. Tas., p. 70.
1921 Ameria pyramidata (Sby.). May, Check-list Moll. Tas., p. 90.
1923 Id. May, Ill. Index Tas. Shells, pl. 41, fig. 14.
1932 Id. Cotton and Godfrey, S. Aust. Nat., xiii, No. 4, p. 161, pl. 2, fig. 8.
1933 Isidorella pyramidata (Sby.). Quick, Journ. Conch., xix, No. 10, p. 322, figs. 1-15 (in text).

Size.—Length, 35 mm.; breadth, 15 mm.

Localities.—Meredith (Nat. Mus. Melb., and J. H. Young); Portland (C. J. Gabriel); Shelford (J. H. Young).

Vernacular Name.—The Pyramidal Pond-Snail.

Observations.—This, the largest of our Victorian sinistral Pond-Snails, is very variable, differing from the dominant form in being longer and with the earlier whorls more inflated. Hedley, in the Records of the Australian Museum, 1917, notes the suggestion of Cooke (P. Z. S. Lond., 1889) in uniting *tenuistriatus* and *pyramidatus.* May (1920) regards *pyramidatus* as worthy of specific rank and places the fol-

lowing Tasmanian forms in synonymy: *eburnea* Sby., *attenuata* Sby., *bruniensis* Sby., *huonensis* Ten. Woods, *legrandi* Ten. Woods, *tasmanica* Ten. Woods, *tasmanicola* Ten. Woods, *? huonicola* Ten. Woods.

The anatomy of the animal is described by Dr. H. E. Quick, who also gives an interesting account of his aquarium observations.

Ameria tenuistriata (Sowerby) var. *waterhousei* (Clessin).

(Pl. I, Fig. 14.)

1886 Physa waterhousei Clessin, Conch. Cab., i, Abth. 17, p. 361, pl. 51, fig. 6.
1917 Bullinus tenuistriatus (Sby.) Hedley, Rec. Aust. Mus., xii, No. 1, p. 3, pl. 1, figs. 7, 8.

Size.—Length, 20 mm.; breadth, 11 mm.

Localities.—Murray R. (W. Kershaw); Gunbower, Wimmera R. (Cox. coll.); Mordialloc (E. H. Matthews); Portland (W. H. Dillon); Lake Boga; Caulfield.

Vernacular Name.—Waterhouse's Pond-Snail.

Observations.—A form with much rounded whorls; it may be compared with *pyramidata* Sby., which, however, has a much longer spire. The accompanying illustrations will serve to show that this variety is much more inflated than the typical form.

Ameria tenuistriata (Sowerby) var. *arachnoidea* (Tenison Woods.)

(Pl. II, Fig. 15.)

1878 Physa arachnoidea Ten. Woods, Tr. Roy. Soc. Vict., xiv, p. 63.
1882 Aplexa arachnoidea (Ten. Woods) Tate, Tr. Roy. Soc. S. Aust., iv, p. 76.
1882 Physa arachnoidea Ten. Woods. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 556.
1882 Id. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 289.
1885 Id. Clessin. Conch. Cab., i, Abth, 17, p. 359.
1917 Bullinus tenuistriatus (Sby.) var. arachnoideus (Ten. Woods). Hedley, Rec. Aust. Mus., xii, No. 1, p. 3, pl. 2, fig. 15.

Size of Type.—Length, 12 mm.; breadth 5·5 mm. Aperture length, 7 mm; breadth, 3·5 mm.

Localities.—Mordialloc (Nat. Mus. Melb); Castlemaine (F. L. Billinghurst); Gardner's Creek (Dr. Cherry); Echuca (Cox coll.); Overland Corner (F. H. Taylor); Dimboola (J. Mulder); Werribee R.; Merri Creek; Williamstown.

Vernacular Name.—The Spider-web Pond-Snail.

Observations.—Four specimens from near Melbourne in the National Museum, Melbourne, constitute the types. One of these is figured by Hedley, who remarks: "It is a comparatively small and slender form. Even among the type lot there is a difference in sculpture; all have fine dense radial hair lines, on one no spiral sculpture is perceptible, on another there are spiral lines of rather distant ciliae, which correspond to spiral lines on the bare shell."

Ameria tenuistriata (Sowerby) var. *confluens* (Hedley).
(Pl. II, Fig. 16.)

1917 Bullinus tenuistriatus var. confluens Hedley, Rec. Aust. Mus., xii, No. 1, p. 4, pl. 1, figs. 9, 10.

Size of Type.—Length, 21 mm.; breadth, 12 mm.

Localities.—Echuca (Type) and Gunbower (Cox coll.); Lake Hattah (J. E. Dixon).

Vernacular Name.—The Echuca Thinly-striated Pond-Snail.

Observations.—A large and thin, narrowly umbilicate variety, with short spire and concave outline. Hedley remarks: "this form makes a nearer approach to *Physa australiana* Conrad, than to any other figured species. But that is shown with the anterior lip contracted to a gutter and with a more gibbous shoulder. Conrad's species is 18 mm. long and comes from the Bogan River, New South Wales. Probably the type of it is still preserved in the Museum at Logan Square, Philadelphia."

Ameria acutispira (Tryon).

Pl. II, Fig. 17.

1866 Physa (Bulinus) acutispira Tryon, Am. Journ. Conch., ii, p. 9, pl. 2, fig. 10.
1882 P. acutispira Tryon. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 557.
1882 P. (Bulinus) acutispira Tryon. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 282, pl. 6, fig. 16 (after Tryon).
1885 P. acutispira Tryon. Clessin, Conch. Cab., i, Abth. 17, p. 242, pl. 34, fig. 1.
1917 Bullinus acutispira (Tryon). Hedley, Rec. Aust. Mus., xii, No. 1, p. 5, pl. 1, figs. 11, 12, 13 (varieties).
1919 Bullinus acutispira (Tryon). Chapman, Pr. Roy. Soc. Vict., xxxii (n.s.), p. 26, pl. 3, fig. 4.

Size of Type.—Length, 12 mm.; breadth, 6 mm.

Localities.—Mordialloc Creek, Muddy Creek, Bunyip River, Oakleigh, Eltham, Lal Lal Falls, Inverloch, Narracan

River (Nat. Mus. Melb.); Williamstown; Horsham; Geelong; Lake Hattah (J. E. Dixon); Box Hill (R. Hall); Studley Park (C. J. Gabriel).

Vernaeular Name.—The Sharp-point Pond-Snail.

Observations.—A very thin, cylindrically ovate, light horn-coloured shell with a sharply pointed and elevated spire. Chapman (op. cit.) remarks that *B. tasmanieus* closely resembles the above species, but the apex is not so acute, nor is the aperture so open.

Ameria aeutispira (Tryon) var. *yarraensis* (Tenison Woods).

(Pl. II, Fig. 18.)

1878 Physa yarraensis Ten. Woods, Tr. Roy. Soc. Vict., xiv, p. 64.
1882 Aplexa yarraensis (Ten. Woods). Tate, Tr. Roy. Soc. S. Aust., iv, p. 76.
1882 Physa Yarraensis Ten. Woods. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 557.
1882 Id. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 289.
1885 Id. Clessin, Conch. Cab., i, Abth. 17, p. 358.
1917 Bullinus acutispira (Tryon) var. yarraensis (Ten. Woods). Hedley, Rec. Aust. Mus., xii, No. 1, p. 5, pl. 2, fig. 16.

Size of Type.—Length, 11 mm.; breadth, 6 mm.

Loealities.—Upper Yarra (Type, Nat. Mus. Melb.); Williamstown; Carrum Creek (T. Worcester).

Vernacular Name.—The Yarra River Sharp-point Pond-Snail.

Observations.—A thin, horny, shining shell, finely longitudinally striate, and with distant spiral lines of ciliae. Differing from *aeutispira* Tryon by its less acuminate spire.

Ameria aeutispira (Tryon) var. *etheridgii* (E. A. Smith).

(Pl. II, Fig. 19.)

1882 Physa Etheridgii Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 288, pl. 6, fig. 25.
1885 Id. Clessin, Conch. Cab., i, Abth. 17, p. 242, pl. 34, fig. 1.
1917 Bullinus acutispira Tryon var. etheridgii Smith. Hedley, Rec. Aust. Mus., xii, No. 1, p. 5.

Size of Type.—Length, 11 mm.; breadth, 6 mm. Aperture, 7 mm. long; 3 mm. wide.

Loeality.—Yan Yean Reservoir.

Vernaeular Name.—Etheridge's Sharp-point Pond-Snail.

Observations.—Smith remarks: "This species resembles in some respects *P. aeutispira* Tryon. The spire, however,

appears to be not so slender, and the colour also is different. The opaque creamy stripes seem to be a character not met with in *P. acutispira;* there are three or four of them on the last whorl."

Hedley, with whom I agree, regards this form worthy of varietal distinction only.

Ameria acutispira (Tryon) var. *tenuilirata* (Smith).

(Pl. II, Fig. 20.)

1882 Physa tenuilirata Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 291, pl. 6, fig. 27.

1917 Bullinus acutispira (Tryon) var. tenuilirata Smith. Hedley, Rec. Aust. Mus., xii, No. 1, p. 5.

Size of Type.—Length, 12 mm.; breadth, 6 mm.

Locality.—Bunyip River (E. A. Smith).

Vernacular Name.—The Thinly Striated Pond-Snail.

Observations.—The type came from Western Australia. Smith remarks: "the distinct elevated spiral lines are far less raised than in the P. aliciae of Reeve, yet more so than in several other Australian forms. The lines of growth are very distinct, and, crossing the spiral lirulae, give the surface a minutely cancellated appearance. Two specimens from the Bunyip River, Victoria, sent by Mr. Petterd to Mr. Taylor, who has submitted them to me, appear to belong to this species. They differ in being of a brownish olivaceous colour, and in having much fewer spiral lines. Neither of them present the yellowish stripe or mark of periodic growth on the last volution, which occurs in most of the examples from Western Australia."

Ameria producta (E. A. Smith).

(Pl. II, Fig. 21.)

1882 Physa producta Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 286, pl. 6, fig. 21.

Size of Type.—Length, 26 mm.; breadth, 10 mm. Aperture, 12·5 mm. long, 5 mm. broad.

Locality.—Wimmera River (Nat. Mus. Melb.).

Vernacular Name.—The Lengthened Pond-Snail.

Observations.—This species is recorded from various parts of New South Wales, but the Victorian record is based on two specimens, each 25 mm. long and 10 mm. broad, presented to the National Museum in 1895 by the late Mr. C. French. Smith remarks: "This species is rather narrower in the

body-whorl than *P. gibbosa* var. *adamsiana* Canefri and those of the spire are perhaps more regular in their enlargement. The colour, too, is not so olivaceous, being rather yellower in tint. *P. attenuata* Sowerby, from Tasmania, has a less acuminate spire, and the body-whorl is conspicuously narrow in proportion to the preceding whorls. *P. gibbosa,* however, may eventually include this species, as certain slender forms approach it very closely."

Genus ISIDORELLA Tate, 1896.

Isidorella newcombi (A. Adams and Angas).

(Pl. II, Fig. 22.)

1864 Physa Newcombi A. Adams and Angas, P. Z. S., Lond, p. 416.
1874 Id. Sowerby, Conch. Icon., xix, pl. 3, fig. 21.
1874 Physa subinflata Sowerby, op. cit., fig. 6a, sp. 5.
1882 Physa Newcombi Ad. and Ang. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 555.
1882 Id. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 280.
1882 Physa Brazieri Smith, op. cit., p. 286, pl. 6, fig. 22.
1885 Physa newcombi Ad. and Ang. Clessin, Conch. Cab., i, Abth. 17, p. 299, pl. 43, fig. 6.
1887 Id. Cooke, J. Conch., v., p. 242.
1887 Limnaea physopsis Cooke, op. cit., p. 243, pl. 2, figs. 1-4.
1889 Id. Cooke, P. Z. S. Lond., pp. 137-140, figs. 7, 7a (radula).
1892 Bulinus Newcombi (Ad. and Ang.) Bednall, Tr. Roy. Soc. S. Aust., xvi, p. 67.
1906 Isidorella newcombi (Ad. and Ang.) Tate, Rept. Horn Exped., ii, Zool., p. 213, pl. 19, fig. 25.
1917 Isodora newcombi (Ad. and Ang.) Odhner, K. Sv. Vet. Ak. Handl., lii (16), p. 74.
1917 Id. Hedley, Rec. Aust. Mus., xii, No. 1, p. 8.
1932 Isodorella newcombi (Ad. and Ang.) Cotton and Godfrey, S. Aust. Nat., xiii, No. 4, p. 159, pl. 2, fig. 4.

Size of Type.—Length, 21 mm.; breadth, 14·6 mm.

Localities.—Cheltenham, St. Kilda, Tatura (Nat. Mus., Melb.); Meredith (J. H. Young); Stawell, Bacchus Marsh (F. L. Billinghurst); Serviceton (T. Worcester); Werribee (W. T. Bednall); Larpent (A. C. Nilson); Melbourne University Lake.

Vernacular Name.—Newcomb's Pond-Snail.

Observations.—A thin, ovate-globose, brownish shell with finely, spirally-striated whorls. Tate, in dealing with the Horn Expedition Mollusca from Central Australia, recorded this species and made the following observations: "*I. newcombi* and its varieties have the test covered by a horny periostracum raised into spiral fringes of hairs and into

imbricating folds at the suture; the spiral rows of hairs are superimposed on the spiral striae of the test; the periostracum is more developed in some individuals than in others, may be partly or wholly removed by abrasion in adult shells, and is usually lost in dead ones. This feature has been unnoticed by the describers of the several species, which may be explained on the probability that their types were dead shells. The colour of the test is mainly light-horn, but varies from olive-green to brown and reddish, and cannot be used as a specific character. *I. newcombi* and its varieties have the habit of burrowing in the mud on the drying up of the water of the pool in which they live, and of forming a hemispheric operculum of fine silt, thus closing the aperture. The fine nature of the material forming the operculum contrasts strongly with the varied texture of the mud of the pool, which leads me to infer that the fine sediment has been selected by swallowing and ejected per anum." Tate further states *brazieri* merges so gradually into the typical form that it can only be regarded as a mere individual variation of *I. newcombi*; with this I agree. Hedley regarded *brazieri* as a variety of *hainesii,* not of *newcombi.*

Isidorella newcombi (Adams and Angas) var. *hedleyi* (Clench).

(Pl. II, Fig. 23).

1864 Physa inflata Adams and Angas, P. Z. S., Lond., p. 39.
1874 Id. Sowerby, Conch. Icon., xix, pl. 1, figs. 4a, b.
1882 Id. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 280.
1886 Id. Clessin, Conch. Cab., i, Abth. 17, p. 300, pl. 43, fig. 7.
1894 Bulinus inflatus (Ad. and Ang.) Whan, Geelong Nat., iv, No. 10, p. 8.
1896 Isidorella inflata (Ad. and Ang.). Tate, Rept. Horn Exp., ii, Zool., p. 213.
1917 Isodora newcombi var. inflata (Ad. and Ang.) Hedley, Rec. Aust. Mus., xii, No. 1, p. 8.
1926 Isidora newcombi hedleyi Clench, Journ. Conch., xviii, No. 1, p. 12 (new name for inflatus preocc.).

Size of Type.—Length, 16·6 mm.; breadth, 12·5 mm.

Localities.—Mount Hope (C. Hedley); Cheltenham (T. Worcester); Irymple (J. H. Young); Birregurra (A. C. Nilson).

Vernacular Name.—Hedley's Inflated Pond-Snail.

Observations.—The type came from the Wakefield River, South Australia. It is a fine, inflated, bulbous form with the upper whorls usually semi-opaque and fuscous, and the lower whorls more pellucid and of a pale greenish horn-

colour. The epidermis is ornamented with regular transverse rows of short hairs. Generally known under the name *inflata* which, through preoccupation, is not available.

Isidorella newcombi (Adams and Angas) var. *pilosa* (Tenison Woods).

(Pl. II, Fig. 24).

1878 Physa pilosa Ten. Woods, Tr. Roy. Soc. Vict., xiv, p. 63.
1882 Id. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 556.
1882 Id. Smith, Journ, Linn. Soc. Lond., Zool., xvi, p. 289.
1885 Id. Clessin, Conch. Cab., i, Abth. 17, p. 358.
1917 Isodora hainesii (Tryon) var. pilosa (Ten. Woods). Hedley, Rec. Aust. Mus., xii, No. 1, p. 7, pl. 2, figs. 19, 20.

Size of Type.—Length, 11 mm.; breadth, 6 mm.

Localities.—Melbourne University Ponds (Types, Nat. Mus., Melb.); Melbourne (J. A. Kershaw); Birregurra (A. C. Nilson); Elaine (J. H. Young); Meredith (E. H. Matthews).

Vernacular Name.—Newcomb's Hairy Pond-Snail.

Observations.—In the National Museum, Melbourne, are four specimens of *P. pilosa* Ten. Woods labelled as the types and registered as 35994-7. One of them, 13 mm. long and 8 mm. broad, is illustrated by Hedley. This figure excellently depicts the shell but, in my opinion, it is a variety of *newcombi* Ad. and Ang., and not of *hainesii* Tryon. It is very close to the variety *crebreciliata* Ten. Woods, but differs in being thinner, lighter in colour, and in having a very thin epidermis, an extremely small spire, and an oblique and interiorly produced aperture. From *newcombi* Adams and Angas, the varieties *pilosa* Ten. Woods and *crebreciliata* Ten. Woods may be distinguished by their smaller, less inflated spires.

Isidorella newcombi (Adams and Angas) var. *crebreciliata* (Tenison Woods).

(Pl. II, Fig. 25).

1878 Physa crebreciliata Ten. Woods, Tr. Roy. Soc. Vict., xiv, p. 63.
— Physa hirsuta Ten. Woods MS.
1882 Physa crebreciliata Ten. Woods. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 556.
1882 Id. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 290.
1882 Aplexa crebreciliata (Ten. Woods). Tate, Tr. Roy. Soc. S. Aust., iv, p. 76.
1886 Physa crebreciliata Ten. Woods. Clessin, Conch. Cab., i, Abth. 17, p. 351, pl. 49, fig. 10.

1914 Bulinus crebreciliatus (Ten. Woods). Chapman, Mem. Nat. Mus., Melb., No. 5, p. 58, pl. 1, fig. 1.
1917 Isodora hainesii (Tryon) var. crebreciliata (Ten. Woods). Hedley, Rec. Aust. Mus., xii, No. 1, p. 7, pl. 2, fig. 21.

Size of Type.—Length, 15 mm.; breadth, 7 mm.

Localities. — Caulfield (Type); Brighton (Nat. Mus., Melb.); Horsham (W. Kershaw); Melbourne (E. H. Matthews); Sandringham.

Vernacular Name.—The Ciliated Pond-Snail.

Observations.—Hedley gives a good figure of the presumed type of *Physa crebrcciliata* Ten. Woods and makes the following comments: "The type of *P. crebreciliata* does not exist under that name in the collection of the Museum at Melbourne. But I have received four specimens, marked '36028-31, *Physa hirsuta* Ten. Woods, Caulfield.' No such species was published by Tenison Woods. The locality, description and comparison of *P. crebrcciliata* suit *'hirsuta'* exactly. I presume, therefore, that the name was changed in course of publication, and that the real types of *'crebreciliata'* are the specimens marked *'hirsuta.'* These specimens are less globose than the original figure published by Clessin and closely correspond to *Physa brazieri* Smith var. *major,* from the Burnett River, Queensland. There are on the body whorl about thirty-two spirals of fine ciliae, decussated by fine, close longitudinal lamellae. The latter, as in the case of *I. newcombi,* rise round the suture into a sort of ruff, or collar. But the epidermis is rarely preserved in so perfect a state. Of the four type specimens, the one which is drawn (Pl. II, Fig. 21) has a comparatively elevated spire, while in the other three the spire is much more depressed. It is 12 mm. long and 8 mm. broad."

Careful study of the type specimens leads me to concur with Hedley's remarks, but I do not agree with him in regarding the form as a variety of *haincsii* Tryon.

Isidorella haincsii (Tryon).

(Pl. II, Fig. 26).

1866 Physa (Isidora) Hainesii Tryon, Am. Journ. Conch., ii, p. 9, pl. 2, fig. 9.
1873 Physa latilabiata Sowerby, Conch. Icon., xix, pl. 5, fig. 33.
1882 Physa Hainesii Tryon. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 556.
1882 Physa (Isidora) Hainesii Tryon. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 281.
1886 Physa hainesii Tryon. Clessin, Conch. Cab., i, Abth. 17, p. 366, pl. 49, fig. 1.

1886 Physa ciliosa Clessin, MSS., op. cit., p. 351.
1886 Physa schrayeri Clessin, MSS., op. cit., p. 366.
1887 Physa hainesii Tryon. Cooke, Journ. Conch., p. 241.
1917 Isodora hainesii (Tryon). Hedley, Rec. Aust. Mus., xii, No. 1, p. 7 (in part).

Size of Type.—Length 9·5 mm.; breadth, 7 mm.

Localities.—Bairnsdale (Miss E. Clark); Bannerton (A. C. Nilson); Geelong, Dimboola (J. Mulder); Keilor (F. S. Colliver); Plenty River, Dandenong (T. Worcester); Bacchus Marsh (F. L. Billinghurst and E. H. Matthews); Reservoir Studley Park (C. J. Gabriel).

Vernacular Name.—Haines's Pond-Snail.

Observations.—Smaller and more elongate than *I. newcombi* Ad. and Ang.

Family **PLANORBIDE**

Genus PLANORBIS Geoffrey 1767.

Planorbis tasmanicus Tenison Woods.

(Pl. III, Fig. 27, 27a, 27b).

— Planorbis McCoyi Ten. Woods MS.
1876 Planorbis tasmanicus Ten. Woods, Pr. Roy. Soc. Tas. for 1875, p. 79.
1879 Id. Johnston, Pr. Roy. Soc. Tas., for 1877, p. 28.
1889 Id. Petterd, Pr. Roy. Soc. Tas., for 1888, p. 68, pl. 2, figs. 8, 9.
1896 Planorbis gilberti Dunker. Fielder, Vict. Nat. xii, No. 11, p. 140.
1917 Id. Cherry, "Bilharziosis," p. 4, figs. 7, 7a.
1920 Planorbis tasmanicus Ten. Woods. May, Pr. Roy. Soc. Tas., p. 70, pl. 10, figs. 13, 14.
1921 Id. May, Check-list Moll. Tas., p. 90, No. 885.
1923 Id. May, Ill. Index Tas. Shells, pl. 41, fig. 19.

Size of Type.—Length 5 mm.; breadth, 3·5 mm.; height, 1 mm.

Localities.—Warburton, Oakleigh, Bairnsdale, Melbourne Botanic Gardens (Nat. Mus., Melb.); R. Murray (J. A. Kershaw); Heidelberg (Rev. W. Fielder); Longford, Tarraville, Lorne (T. Worcester); Lake Hattah (J. E. Dixon); Geelong (H. W. Davey); Birregurra (A. C. Nilson); Meredith (J. H. Young); Sydenham (F. S. Colliver); Blackburn Lake (A. C. McLachlan); Belgrave, Hall's Gap (C. Oke); Studley Park Reservoir (C. J. Gabriel).

Vernacular Name.—Tasmanian Flat-coil or Ram's horn Pond-Snail.

Observations.—These flatly-discoidal little shells are generally found harbouring among weeds in stagnant and slow-

running water. It is the commonest and most widely distributed of the Victorian *Planorbidae*. It is subject to considerable variation, more particularly in the sharpness and position of the keel; that these features are individual variations I am convinced after examining thousands of specimens from all parts of the State. Three shells labelled Type in the National Museum collection, Reg. No. 36083-5, with locality Melbourne, appear under the name of *Planorbis mccoyi* Ten. Woods. I have failed to find any evidence that this name has been published. These specimens are inseparable from the species under discussion. Tenison Woods (Pr. Roy. Soc. Tas., 1879, p. 72) withdrew *P. tasmanicus* in favour of *P. meridionalis* Braz., under the impression that he had redescribed the same shell, an opinion not accepted by Petterd or May. From the original descriptions and figures provided by these authors, I am inclined to agree that *tasmanicus* and *meridionalis* are distinct species.

Planorbis scottiana Johnston.

(Pl. III, Figs. 28, 28a, 28b).

1879 Planorbis scottiana Johnston, Pr. Roy. Soc. Tas., for 1878, p. 26.
1889 Id. Johnston, ibid. for 1888, p. 86, pl. 6, figs. 2a, b, c.
1920 Id. May, Pr. Roy. Soc. Tas., p. 70, pl. 10, fig. 12.
1921 Id. May, Check-list Moll. Tas., p. 90, No. 884.
1923 Id. May, Ill. Index Tas. Shells, pl. 41, fig. 18.

Size of Type.—Greatest diam., 2·5 mm.; smallest diam., 2 mm.; height, 0·5 mm.

Locality.—Tarraville (T. Worcester).

Vernacular Name.—Scott's Flat-coil or Ram's horn Pond-Snail.

Observations.—A very minute, thin, pale, horny-coloured shell, somewhat flattened above and below; finely transversely striated. It is the smallest representative of the genus in Victoria and is easily distinguished from our other species.

Planorbis waterhousei Clessin.

(Pl. III, Figs. 29, 29a, 29b).

1886 Planorbis waterhousei Clessin, Conch. Cab., i, Abth. 17, p. 188, pl. 28, fig. 2.

Size of Type.—Diameter, 4·5 mm., height, 0·7 mm.

Locality.—Portland (W. H. Dillon).

Vernacular Name.—Waterhouse's Flat-coil or Ram's-horn Pond-Snail.

Observations.—The National Museum, Melbourne, has fine examples of this species from Clarence River, New South Wales, the type locality. The Victorian record is based on a series from the cabinet of the late Mr. W. H. Dillon, and although the whorls are a little rounder than those of *waterhousei* from the type locality, these shells are otherwise indistinguishable. Clessin remarks that specimens collected by Waterhouse are in the Berlin Museum under the name of *olivaceus,* an unpublished appellation by Cox; this name was not available, being preoccupied by Spix.

Genus SEGMENTINA Fleming 1838.

Segmentina victoriae Smith.

(Pl. III, Figs. 30, 30a, 30b).

1882 Segmentina victoriae Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 296, pl. 7, figs. 11-13.
1894 Planorbis victoriae (Smith). Whan, Geelong Nat., iv, No. 10, p. 9.
1896 Id. Fielder, Vict. Nat., xii, No. 11, p. 140.
1920 Segmentina victoriae Smith. May, Pr. Roy. Soc. Tas., p. 70.
1921 Id. May, Check-list Moll. Tas., p. 90, No. 886.
1923 Id. May, Ill. Index Tas. Shells, pl. 41, fig. 20.
1932 Id. Cotton and Godfrey, S. Aust. Nat., xiii, p. 163, pl. 3, fig. 13.
1936 Id. Cotton, S. Aust. Nat., xvii, Nos. 1-4, p. 85, fig. 45.

Size of Type.—Greatest diam., 4 mm.; smallest diam., 3·5 mm.; height, 1·3 mm.

Localities.—Melbourne Botanic Gardens, Studley Park (Nat. Mus., Melb.); Heidelberg (Fielder); Meredith (J. H. Young); Birregurra (A. C. Nilson); Lake Wendouree (J. Searle); Melbourne University Lake (J. A. Kershaw); Sale (W. Kershaw).

Vernacular Name.—The Victorian Segmentina.

Observations.—A thin, glossy, chestnut, disc-like shell, rather acutely keeled a little below the middle of the last whorl. It resembles *S. australiensis* Smith from Penrith, New South Wales, but is not so flattened beneath, the sunken spire is smaller, and the umbilicus narrower; internal lamellae absent. Smith remarks: "It appears inconsistent to place a shell in the genus *Segmentina* lacking the essential character of internal lamellae. However, its '*tout-ensemble*' is so Segmentinoid, that I feel sure that it is an abnormal form of that group."

This species frequents stagnant water and slow-running streams.

Family **ANCYLIDAE**

Genus ANCYLUS Geoffroy 1767.

Ancylus australicus Tate.

(Pl. III, Figs. 31, 31a).

1880 Ancylus Australicus Tate, Tr. Roy. Soc. S. Aust., iii, p. 102, pl. 4, figs. 4a-b.
1882 Id. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 559.
1882 Id. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 297, pl. 7, figs. 36, 37.
1893 Id. Billinghurst, Vict. Nat., x, p. 63.
1896 Id. Tate, Rept. Horn Exp., Zool., ii, p. 216.
1917 Id. Odhner, K. Sv. Vet. Ak. Handl., lii, (16), p. 74.
1917 Id. Cherry, "Bilharziosis," p. 4, figs. 12, 12a.
1932 Id. Cotton and Godfrey, S. Aust. Nat., xiii, No. 4, p. 164, pl. 3, fig. 11.
1936 Id. Cotton, S. Aust. Nat., xvii, Nos. 1-4, p. 84, fig. 41.

Size of moderately large example. — Length, 4 mm.; breadth, 2·5 mm., height 1·5 mm.

Localities.—Melbourne (Tate); Frankston (J. A. Kershaw); Alphington, Melbourne Botanic Gardens (J. Searle); Lake Wendouree, Meredith (J. H. Young); Blackburn Lake (A. L. McLachlan); Tarraville (T. Worcester); Castlemaine, Studley Park (C. J. Gabriel).

Vernacular Name.—Freshwater Limpet.

Observations.—This, our commonest freshwater Limpet, is usually found on the under surface of floating leaves. The shell is pale, thin and delicate; conic depressed, lengthened; sides subrectilinear or slightly convex, diverging slightly forwards; apex blunt post median, with about two-fifths of the shell behind it, inclining backwards, and directed towards the right; the line from the apex to posterior border slightly concave, to the anterior border almost rectilinear; peritreme oval, distinctly narrowed posteriorly. It has a wide distribution, being recorded in South and Central Australia and as far north as Arnheim Land. Odhner, recording it from the Fitzroy River, remarks: "The position of the apex is somewhat variable inasmuch as it may be nearly medium or more distinctly to the right; it is always situated at the posterior third of the shell. The anterior slope is a little more convex than in the figures of E. A. Smith (op. cit.), the shells a trifle more depressed and the apex directed to the right (not to the left as in the figures)."

Ancylus tasmanicus Tenison Woods.

(Pl. III, Figs. 32, 32a).

1875 Ancylus tasmanicus Ten. Woods, Pr. Roy. Soc. Tas., p. 70.
1879 Id. Johnston, Pr. Roy. Soc. Tas., p. 25.
1894 Id. Whan, Geelong Nat., iv, No. 10, p. 9.
1896 Id. Fielder, Vict. Nat., xii, No. 11, p. 140.
1920 Id. May, Pr. Roy. Soc. Tas., p. 71, pl. 10, figs. 15, 16.
1921 Id. May, Check-list Moll. Tas., p. 90.
1923 Id. May, Ill. Index Tas. Shells, pl. 41, fig. 22.

Size of Type.—Length, 3-3·5 mm.; breadth, 1·5-2 mm.; height, 1·5-2 mm.

Localities.—Heidelberg (Rev. W. Fielder); Moorabool R. (J. H. Young); Frankston (J. A. Kershaw and T. Worcester); Nangeela (Rev. Whan); Lorne (C. J. Gabriel).

Vernacular Name.—Tasmanian Freshwater Limpet.

Observations—A very small, ovate, diaphanous, horny shell, concentrically striate and very faintly rugosely radiate, more or less covered and spotted with a black epidermis, apex obtuse. From *A. australicus* Tate, it is distinguished by its proportionately greater height, and its obtuse apex. W. L. May (1920) regards *A. mariae* Petterd as possibly a variant of *tasmanicus* Ten. Woods, but in 1921 records these two forms as distinct species. Petterd, *Journal of Conchology,* iv., 1884, p. 159, remarks: "that his own species *A. assimilis* from Richmond River, New South Wales, is close to *A. tasmanica* Ten. Woods and may prove to be identical. It appears to be broader, with the apex more twisted." Common on eucalyptus leaves, Erskine River, Lorne.

Genus GUNDLACHIA Pfeiffer, 1849.

Gundlachia petterdi Johnston.

(Pl. III, Fig. 33).

1879 Gundlachia petterdi Johnston, Pr. Roy. Soc. Tas., p. 23.
1897 Ancylus woodsii Johnston, Pr. Roy. Soc. Tas., p. 25.
1881 Gundlachia Petterdi Johnston. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 559.
1884 Id. Tate, Pr. Roy. Soc. Tas., p. 216.
1888 Gundlachia beddomei Petterd, Pr. Roy. Soc. Tas., for 1887, p. 41, pl. 44.
1893 Gundlachia petterdi Johnston. Hedley, Vict. Nat., x, No. 9, p. 148, left fig.
1893 Gundlachia beddomei Petterd. Hedley, op. cit., right fig.
1894 Gundlachia petterdi Johnston. Hedley, Pr. Linn. Soc. N.S.W., (2 ser.), viii, p. 509, pl. 24, figs. 1-3, and 7-11.

1894 Gundlachia beddomei Petterd, MS. Hedley, op. cit., p. 513, pl. 24, figs. 4-6.
1895 Id. Hedley, Pr. Linn. Soc. N.S.W., (2 ser.), ix, p. 464.
1920 Gundlachia petterdi Johnston. May, Pr. Roy. Soc. Tas., p. 71.
1921 Id. May, Check-list Moll. Tas., p. 91.
1923 Id. May, Ill. Index Tas. Shells, pl. 41, fig. 25.
1932 Id. Cotton and Godfrey, S. Aust. Nat., xiii, No. 4, p. 164, pl. 3, fig. 12.
1936 Id. Cotton, S. Aust. Nat., xvii, Nos. 1-4, p. 84, fig. 42.

Size of Type.—Length, 2·5-3 mm.; breadth, 1-5-1·75 mm.; height, ·5-·75 mm.

Localities.—Heidelberg (Rev. W. Fielder); Alphington (J. Searle); Blackburn Lake (A. L. McLachlan).

Vernacular Name.—Petterd's Freshwater Limpet.

Observations.—Shell minute, thin, pale horn in colour, diaphanous, spirally oblong in two distinct tiers, apex obliquely inclined posteriorly, concentrically striate and crossed by fine, radiating lirae, apical tier more incrusted with confervoid matter, and appearing partially and obliquely exserted upon the basal tier; projecting portion of apical tier as well as one-third of the basal one closed by a flat horizontal plate, all in the plane of the original aperture of apical tier; outer aperture broadly ovate; lip of basal tier continuous, although modified at junction with apical tier; inner aperture semi-circular, and determined to a great extent by the original aperture of apical tier; inner lip with slightly raised rim continuous, simple. The juvenile shell is simple, and resembles the common *Ancylus*.

G. petterdi is easily recognized. It is common on dead leaves and sticks. The species is also recorded from Tasmania and South Australia. *Ancylus woodsii* Johnston is undoubtedly the immature form.

The genus *Gundlachia* is found in America and in Cuba.

LAMELLIBRANCHIATA.

Family **CORBICULIDAE.**

Genus CORBICULA Megerle, 1811.

Corbicula angasi Prime.

(Pl. IV, Fig. 34.)

1864 Corbicula Angasi Prime, Jour. de Conch., xii, p. 151, pl. 7, fig. 6.
1878 Cyrena Angasi (Prime). Sowerby, Conch. Icon., xx, pl. 17, fig. 90.
1879 Corbicula rivina Clessin, Conch. Cab., p. 139, pl. 25, figs. 3, 4.

1882 Corbicula Angasi Prime. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 566.
1882 Id. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 302.
1887 Id. Tate, Tr. Roy. Soc. S. Aust., ix, p. 94.
1893 Id. Adcock, Hand-List Aquatic Moll. S. Aust., p. 12.
1894 Id. Whan, Geelong Nat., iv, No. 10, p. 9.
1903 Corbicula (Corbiculina) angasi Prime. Dall, Tr. Wag. Inst. Phil., iii, p. 1,449.
1936 Corbicula angasi Prime. Cotton, S. Aust. Nat., xvii, Nos. 1-4, p. 85, fig. 46.

Size.—Length, 20 mm.; breadth, 24 mm.

Localities.—Altona, Skipton, Kerang, Albert Park Lake (Nat. Mus., Melb.); Geelong (J. Mulder); Chalka Creek (A. S. Kenyon); Casterton (Rev. Whan); Hamilton (W. H. Dillon and F. S. Colliver); Shelford (J. H. Young); Gayfield (A. C. Nilson); Lake Hindmarsh (Gresswell); Studley Park (C. J. Gabriel).

Vernacular Name.—Angas's Little Basket Shell.

Observations.—Abundant in Victoria and South Australia. The shells are frequently covered by a reddish earthy deposit, removal of which discloses a straw-coloured epidermis. Externally and internally the colouring is subject to considerable variation. Prime describes it as pale orange, and sometimes whitish, but specimens before me are rich purple, while others are of a distinct pinkish tint, often in bands. Whan records *C. deshayesi* Smith from Colac; not having examined Whan's specimens, I cannot speak with certainty, but, as *C. angasi* is very abundant in this locality and as *C. deshayesi* is recorded from Victoria River and Port Essington, North Australia, Whan's record requires verification. Dall makes *C. angasi* Prime the type of his new section *Corbiculina.*

Family **CYCLADIDAE.**

Genus SPHAERIUM Scopoli, 1777.

Sphaerium tasmanicum (Tenison Woods).

(Pl. IV, Fig. 35.)

1876 Cylas tasmanica Ten. Woods, Pr. Roy. Soc. Tas., p. 82.
1882 Sphaerium Tasmanicum (Ten. Woods). Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 565.
1882 Sphaerium Macgillivrayi Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 305, pl. 7, fig. 34.
1887 Id. Tate, Tr. Roy. Soc. S. Aust., ix, p. 94.
1893 Id. Adcock, Hand-List Aquatic Moll. S. Aust., p. 12.
1914 Sphaerium tasmanicum (Ten. Woods). Chapman, Mem. Nat. Mus. Melb., No. 5, p. 56.

1920 Sphaerium macgillivrayi Smith. May, Pr. Roy. Soc. Tas., p. 68, pl. 9, fig. 1.
1921 Id. May, Check-list. Moll. Tas., p. 21, No. 152.
1923 Id. May, Ill. Index Tas. Shells, pl. 9, fig. 9.
1923 Sphaerium tasmanicum (Ten. Woods). May, Ill. Index Tas. Shells, pl. 9, fig. 9.
1936 Sphaerium macgillivrayi Smith. Cotton, S. Aust. Nat., xvii, Nos. 1-4, p. 85, fig. 48.

Size of Type.—Length, 9 mm.; breadth, 7·5 mm.; height, 5 mm.

Localities.—Melbourne University Lake (Nat. Mus., Melb.); Carrum, Tarraville, Longford (T. Worcester); Meredith, Anakie (J. H. Young); Dandenong (J. A. Kershaw); Moorooduc (Rev. G. Cox); Birregurra (A. C. Nilson); N. Portland (C. J. Gabriel).

Vernacular Name.—Tasmanian Orb Shell.

Observations.—A thin, fragile shell, subquadrate, ventricose, shining, fleshy-yellow, striate, white inside, with lines of growth indicated by three or four silver-like bands of colour; umbones prominent. In South Australia Cotton has recorded this species under the name of *S. macgillivrayi* Smith, but I have no doubt this name is synonymous with the earlier *S. tasmanicum* Ten. Woods. In Tasmania, May regards *tasmanicum* and *macgillivrayi* as distinct, remarking that the latter is less round and has more prominent umbones, variations discernible in the Victorian form.

Sphaerium problematicum sp. nov.

(Pl. IV, 36, 36a, 36b.)

Shell thin, hyaline white, nearly equilateral, moderately inflated, transversely ovate; anteriorly narrower and more acuminate than at the posterior end. Umbones fairly prominent. Surface of shell bearing minute concentric striae. Internally white.

Size of Type.—Length, 4·75 mm.; breadth, 7 mm.

Locality.—Murray River, near Merbein. Collected by F. S. Colliver.

Vernacular Name.—The Oval Orb Shell.

Observations.—A distinctive little species somewhat approaching *S. tasmanicum* Ten. Woods, but more ovate in form.

Type in the National Museum, Melbourne. Reg. No. 71231.

Genus PISIDIUM Pfeiffer, 1875.

Pisidium etheridgii E. A. Smith.

(Pl. IV, Fig. 37.)

1882 Pisidium Etheridgii Smith, Journ. Linn. Soc. Lond., Zool., xvi, 306, pl. 7, fig. 35.
1887 Pisidium Etheridgei Smith. Tate, Tr. Roy. Soc. S. Aust., ix, p. 94.
1893 Pisidium Etheridgei Smith. Adcock, Hand-List Aquatic Moll. S. Aust., p. 12.
1894 Cyclas (Pisidium) etheridgei Smith. Whan, Geelong Nat., iv., No. 10, p. 9.
1936 Pisidium etheridgei Smith. Cotton, S. Aust. Nat., xvii, Nos. 1-4, p. 85, fig. 47.

Size of Type.—Length, 5·5 mm.; breadth, 6·5 mm.; diam., 3·5 mm.

Localities.—Yan Yean Reservoir (R. Etheridge); Port Fairy (Rev. Whan); Fall's Creek Reservoir (Nat. Mus., Melb.); Mt. Baw Baw (J. Searle); Bangholme, Tarraville (T. Worcester); Blackburn Lake (A. C. McLachlan); "The Sanctuary" at Lorne, Studley Park (C. J. Gabriel).

Vernacular Name.—Etheridge's Pea Shell.

Observations.—The smallest Victorian freshwater bivalve. Smith remarks: "Umbones rather prominent, with the young shell forming a more or less distant apical cap. Concentric striae very fine. Not unlike the European *P. casertanum,* but rather less inequilateral."

Family **UNIONIDAE.**

Genus HYRIDELLA Swainson, 1840.

Hyridella australis (Lamarck).

(Pl. IV, Fig. 38.)

1819 Unio australis Lamarck, Anim. S. Vert., Ed. 1, vi, p. 80.
1836 Margarita (Unio) depressus Lea, Syn., p. 32.
1843 Unio australis (Lam.) Hanley, Bivalve Shells, p. 192, pl. 21, fig. 25.
1850 Unio balonnensis Conrad, Pr. Ac. Nat. Sci. Phil., v, p. 10.
1856 U. shuttleworthi Kuster, Conch. Cab., Unio, p. 152, pl. 44, fig. 2.
1861 U. philippianus Kuster, op. cit., p. 235, pl. 79, fig. 2.
1868 U. moretonicus Reeve, Conch. Icon., pl. 24, fig. 118.
1871 U. danieli Villa, Jour. de Conch., xix, p. 328.
1882 U. bednalli Tate, Tr. Roy. Soc. S. Aust., v, p. 56.
1882 U. australis Lam. Tate and Brazier, Pr. Linn. Soc. N.S.W., vi, p. 567.
1882 Id. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 309.
1888 Id. Cox, Pr. Linn. Soc. N.S.W., iii (2), p. 1,253.
1888 Id. Tate, Tr. Roy. Soc. S. Aust., xi, p. 69.

1889 Unio legrandi Pett., Pr. Roy. Soc. Tas., p. 81.
1900 Diplodon australis (Lam.) Hanley. Simpson, Pr. U.S. Nat. Mus., xxii, p. 890.
1900 Diplodon (Hyridella) australis var. legrandi Petterd. Simpson, op. cit., p. 891.
1900 Diplodon moretonicus (Reeve). Simpson, op. cit., p. 891.
1921 Diplodon australis (Lam.). May, Check-list Moll. Tas., p. 21, No. 155.
1921 Diplodon moretonicus (Reeve). May, op. cit., p. 21, No. 156.
1923 Id. May, Ill. Index Tas. Shells, pl. 9, fig. 12.
1923 Diplodon australis (Lam.). May, op. cit., pl. 9, fig. 11.
1932 Hyridella australis (Lam.). Cotton and Gabriel, Pr. Roy. Soc. Vict., xliv, (n.s.), Pt. 2, p. 155, pl. 16, fig. 1.
1934 Id. Cotton, S. Aust. Nat., xv, p. 113, pl. 2.
1934 Velesunio balonnensis (Conrad). Iredale, Aust. Zool., viii, Pt. 1, p. 59, pl. 3, figs. 1-3; pl. 4, figs. 1-3.
1934 Velesunio danellii (Villa). Iredale, op. cit., p. 60, pl. 3, fig. 4; pl. 4, fig. 4.
1934 Velesunio shuttleworthi (Kuster). Iredale, op. cit., p. 60, pl. 3, fig. 5, pl. 4, fig. 5.
1934 Hyridunio australis (Lam.). Iredale, op. cit., p. 69, pl. 5, figs. 1, 2; pl. 6, figs. 2, 3.
1934 Hyridunio australis orion Iredale, op. cit., p. 69.
1934 Velesunio danelli (Villa). Allan, Vict. Nat., li, No. 7, p. 166, fig. in text.
1934 Hyridella australis (Lam.) Thiele, Hdbch. Syst. Weichtierkunde, p. 838.

Size of Average Specimen.—Length, 44 mm.; breadth, 71 mm.

Localities.—R. Yarra; R. Tanjil, near Longford; R. Mitchell; Chalka Creek, near R. Murray; Longerenong (J. L. Gatliff); Birregurra; Lake Lonsdale (C. L. Barrett); R. Glenelg (W. H. Dillon); R. Goulburn; R. Mackenzie (C. J. Gabriel); and many localities (Nat. Mus., Melb.).

Vernacular Name.—The Southern Freshwater Mussel.

Observations.—Our commonest freshwater Mussel, enjoying a wide distribution in all Australian States. After examining thousands of specimens, I am convinced of the specific identity of the many varying forms enumerated in the above synonymy. This species is the genotype of *Hyridella. H. ambigua* (Phil.) from New South Wales and South Australia is distinguished from *H. australis* (Lam.) by being thinner, higher, more compressed and lighter coloured.

Hyridella angasi (Reeve).

(Pl. IV, Fig. 39.)

1856 Unio shuttleworthi Lea, Pr. Ac. Nat. Sci. Phil., viii, p. 94 (nom. preocc.).

1868 U. angasi Sowerby. Reeve, Conch. Icon., p. 55, fig. 282.
1882 U. angasi Reeve. Tate, Tr. Roy. Soc. S. Aust., v, p. 56.
1882 U. Angasi Lea. Smith, Jour. Linn. Soc. Lond., Zool., xvi, p. 307.
1888 U. angasi Sby. Tate, Tr. Roy. Soc. S. Aust., xi, p. 69.
1900 Diplodon (Hyridella) shuttleworthi (Lea). Simpson, Pr. U.S. Nat. Mus., xxii, p. 893.
1917 Diplodon shuttleworthi (Lea). Odhner, K. Sv. Vet. Ak. Handl., lii, (16), p. 74.
1932 Hyridella angasi (Reeve). Cotton and Gabriel, Pr. Roy. Soc. Vict., xliv, (n.s.), Pt. 2, p. 157, pl. 16, fig. 3.
1934 Centralhyria angasi (Reeve). Iredale, Aust. Zool., viii, Pt. 1, p. 66, pl. 5, fig. 4; pl. 6, fig. 1.

Size of Average Specimen.—Length, 58 mm.; breadth, 100 mm.

Locality.—Cramenton; R. Murray (Nat. Mus., Melb.).

Vernacular Name.—Angas's Freshwater Mussel.

Observations.—This elongated form is easily recognized; it is the largest Victorian freshwater Mussel. The nacre, as Smith notes, is sometimes entirely white, bluish, or purplish; but the upper and posterior parts are nearly always more or less stained with livid purple, or olive, or a combination of these colours which is difficult to define.

Genus PROPEHYRIDELLA Cotton and Gabriel, 1932.

Propehyridella nepeanensis (Conrad).

(Pl. IV, Fig. 40.)

1830 Unio depressus Lesson, Voy. Coquille, ii, p. 427, pl. 15, fig. 5 (nom. preocc.).
1850 U. nepeanensis Conrad, Pr. Ac. Nat. Sci. Phil., v, p. 10.
1852 Id. Conrad, Jour. Ac. Nat. Sci. Phil., ser. 2, p. 297, pl. 26, fig. 4.
1865 Unio lessoni Kuster, Conch. Cab., pl. 36, fig. 4.
1865 U. nepeanensis Conrad. Reeve, Conch. Icon., xvi, pl. 23, fig. 10.
1882 Id. Smith, Journ. Linn. Soc. Lond., Zool., xvi, p. 312.
1900 Diplodon (Hyridella) dorsuosus Gould. Simpson, Pr. U.S. Nat. Mus., xxii, p. 889.
1900 Diplodon (Hyridella) lessoni (Kuster). Simpson, ibid., p. 890.
1932 Propehyridella nepeanensis (Conrad). Cotton and Gabriel, Pr. Roy. Soc. Vict., xliv, (n.s.), Pt. 2, p. 158, pl. 16, fig. 5.
1934 Id. Iredale, Aust. Zool., viii, Pt. 1, p. 73 (in part), pl. 5, figs. 11, 12 (not 13); pl. 6, figs. 11, 12 (not 13).
1934 Hyridella (Propehyridella) nepeanensis (Conrad). Thiele, Hdbch. Syst. Weichtierkunde, p. 838.

Size of Average Specimen.—Length, 38 mm.; breadth, 62 mm.

Localities.—Mitchell River at Bairnsdale (J. A. Kershaw,

T. Worcester, and Nat. Mus., Melb.); Gippsland Lakes (Dr. J. C. Cox); Wallagaraugh River, East Gippsland.

Vernacular Name.—The Nepean River Corrugated Mussel.

Observations.—Compared with specimens from the Nepean River, New South Wales. The species is readily identified by the coarse wrinkles upon the umbones and its comparatively square or truncated anterior end. Iredale regards *P. narracanensis* C. and G., as the juvenile form, an opinion not accepted by Cotton and Gabriel (see remarks under *P. narracanensis*). This species is the genotype of *Propehyridella.*

Propehyridella cultelliformis (Conrad).

(Pl. IV, Fig. 41.)

1819 Unio depressus Lamarck, An. S. Vert., vii, p. 79 (nom. preocc. Donovan, 1801).
1841 Id. Delessert, Rec. Coq. Lam., pl. 12, fig. 5.
1850 Unio cultelliformis Conrad, Pr. Ac. Nat. Sci. Phil., v, p. 10.
1850 U. profugus Gould, Pr. Boston Soc. Nat. Hist., p. 295.
1854 U. depressus Lam. Lea, Jour. Ac. Nat. Sci. Phil., p. 295, pl. 26, fig. 2.
1859 U. mutabilis Lea, Pr. Ac. Nat. Sci. Phil., iii, p. 152.
1860 Id. Journ. Ac. Nat. Sci. Phil., iv, p. 248, pl. 28, fig. 127.
1862 U. paramattensis Lea, op. cit., iv, p. 176.
1862 U. (Niaa) depressus Lam. Chenu, Man. de Conch., ii, p. 140, fig. 679.
1866 U. paramattensis Lea, Jour. Ac. Nat. Sci. Phil., ser. 2, vi, p. 60, pl. 20, fig. 59.
1882 U. depressus Lam. Smith, Jour. Linn. Soc. Lond., Zool., xvi, p. 308.
1887 Id. Tate, Tr. Roy. Soc. S. Aust., xi, p. 101.
1900 Diplodon (Hyridella) mutabilis (Lea). Simpson, Pr. U.S. Nat. Mus., xxii, p. 308.
1900 Diplodon (Hyridella) profugus Gould. Simpson, op. cit., p. 891.
1914 Diplodon cultelliformis (Conrad). Simpson, Cat. Naiades, iii, p. 1300.
1914 D. mutabilis (Lea). Simpson, op. cit., p. 1308.
1932 Propehyridella cultelliformis (Conrad). Cotton and Gabriel, Pr. Roy. Soc. Vict., xliv (n.s.), p. 159, pl. 16, fig. 6.
1934 Hyridunio renutus Iredale, Aust. Zool., viii, Pt. 1, p. 69, pl. 5, fig. 3; pl. 6, fig. 4.
1934 Rugoshyria depressa (Lam.). Iredale, op. cit., p. 71.
1934 R. depressa vicinalis Iredale, op. cit., p. 72.
1934 R. cultelliformis (Conrad). Iredale, op. cit., p. 73.

Size.—Length, 41 mm.; breadth, 84 mm.

Localities.—Bunyip (Nat. Mus., Melb.); Glengarry River; Mitchell River, at Bairnsdale; River Yarra at Wooriyallock; R. Erskine at Lorne; R. Wallagaraugh, East Gippsland; Tarra Creek; Heidelberg; Lilydale, Mt. Evelyn (M. E. Gatliff); Mallacoota (C. L. Barrett).

Vernacular Name.—The Little Knife-shaped Mussel.

Observations.—Delessert's figure is that of a juvenile. In very young specimens the uneroded umbones are distinctly wrinkled. When working at this extremely variable form in conjunction with Cotton, we examined a very large series from several localities, and after careful study arrived at the conclusions indicated in the above synonymy. Iredale differed, but, after closely studying his remarks, we hold to our original opinion.

Propehyridella narracanensis Cotton and Gabriel.

(Pl. IV, Fig. 42.)

1932 Propehyridella narracanensis C. and G., Pr. Roy. Soc. Vict., xliv, (n.s.), Pt. 2, p. 159, pl. 16, fig. 8.

1934 Propehyridella nepeanensis narracanensis C. and G. Iredale, Aust. Zool., viii, Pt. 1, p. 74, pl. 5, fig. 13; pl. 6, fig. 13.

Size of Type.—Length, 15·5 mm.; breadth, 25·3 mm.

Localities.—Narracan River, at Thorpdale, Gippsland (Type, Nat. Mus., Melb), collected by W. Kershaw; Birregurra.

Vernacular Name.—The Narracan River Corrugated Mussel.

Observations.—A small, dull, yellowish-brown species; the Birregurra examples are darker and a little more inflated, but otherwise inseparable.

Iredale remarks: "The species named *narracanensis* by Cotton and Gabriel is undoubtedly the very juvenile form of the specimens regarded by them as *nepeanensis.*" With this opinion we cannot agree. Re-examination of our material endorses our conviction that the two are definite species; they differ consistently in contour and the umbonal wrinkles are of dissimilar design. We cannot conceive that *narracanensis* could develop into the robust *nepeanensis,* which has a comparatively square or truncated anterior end.

Genus PROTOHYRIDELLA Cotton and Gabriel, 1932.

Protohyridella glenelgensis (Dennant).

(Pl. IV, Fig. 43.)

1898 Unio glenelgensis Dennant, Pr. Roy. Soc. Vict., x, p. 112, pl. 4.

1900 Diplodon (Hyridella) glenelgensis (Dennant). Simpson, Pr. U.S. Nat. Mus., xxii, p. 889.

1914 Diplodon glenelgensis (Dennant). Simpson, Cat. Naiades, iv, p. 1290.

1932 Protohyridella glenelgensis (Dennant). Cotton and Gabriel, Pr. Roy. Soc. Vict., xliv (n.s.), Pt. 2, p. 160, pl. 16, fig. 9.
1934 Id. Iredale, Aust. Zool., viii, Pt. 1, p. 74, pl. 5, fig. 14; pl. 6, fig. 14.
1934 Hyridella (Protohyridella) glenelgensis (Dennant). Thiele, Hdbch. Syst. Weichtierkunde, p. 838.

Size of Type.—Length, 23 mm.; breadth, 40 mm.

Localities.—Glenelg River, at Roseneath (Nat. Mus., Melb., Type and Rev. W. Whan); Glenelg River, at Dartmoor (J. Dennant and W. H. Dillon); Wannon Creek, Hamilton (Nat. Mus., Melb.).

Vernacular Name.—The Glenelg River Corrugated Mussel.

Observations.—A small species apparently confined to Victoria. The surface of shell is rough and has two series of ornamentations, one consisting of undulating concentric ridges, a few of which are coarsely crenulated, and the other of five or six rows of irregular, prominent, nodose wrinkles, angularly arranged around the umbo and with deeply-cut interspaces. The latter series of markings is oblique to the former and constitutes a characteristic rib-like ornament. This peculiar sculpturing, which occupies the greater portion of the shell, readily distinguishes it from other Australian freshwater mussels.

This species is the genotype of Protohyridella.

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Explanation of Plates I-IV.

Plate I.

Fig. 1. Melania balonnensis Conrad. Reg. No. 71204. R. Murray, near Gayfield, Victoria.
Fig. 2. Vivipara hanleyi (Frauenfeld). Reg. No. 71205. R. Murray, near Swan Hill, Victoria.
Fig. 3. Bythinella nigra (Quoy and Gaimard). Reg. No. 71206. Dromana.
Fig. 3a. Bythinella nigra (Quoy and Gaimard) var. Reg. No. 71207. Dromana.
Fig. 4. Bythinella buccinoides (Quoy and Gaimard). Reg. No. 71208. Merri Creek, Coburg, Victoria.
Fig. 5. Bythinella grampianensis sp. nov. Type. Reg. No. 71209. Dairy Creek, near Silver Band Falls, Grampians, Victoria.
Fig. 6. Limnaea lessoni Deshayes. Reg. No. 71210. Longford, Victoria.
Fig. 7. Limnaea subaquatilus Tate. Co-type. Reg. No. 71211. R. Torrens, South Australia.
Fig. 8. Limnaea gunni Petterd. Reg. No. 71212. Tarraville, Victoria.
Fig. 9. Limnaea victoriae Smith. After E. A. Smith, Journ. Linn. Soc. Lond., Zool., xvi, pl. 5, fig. 16. Bairnsdale, Victoria.

Fig. 10. Myxas papyracea (Tate). Reg. No. 71213. Birregurra, Victoria.
Fig. 11. Ameria aliciae (Reeve). Reg. No. 71214. Meredith, Victoria.
Fig. 12. Ameria tenuistriata (Sowerby). Reg. No. 71215. Swan Hill, Victoria.
Fig. 13. Ameria tenuistriata (Sowerby) var. pyramidata (Sowerby). Reg. No. 71216. Portland, Victoria.
Fig. 14. Ameria tenuistriata (Sowerby) var. waterhousei (Clessin). Reg. No. 71217. Caulfield, Victoria.

PLATE II.

Fig. 15. Ameria tenuistriata var. arachnoidea (Ten. Woods). Type. Reg. No. 36001-5. Near Melbourne.
Fig. 16. Ameria tenuistriata var. confluens (Hedley). After Hedley, Rec. Aust. Mus., xii, No. 1, pl. 1, fig. 9. Echuca, Victoria.
Fig. 17. Ameria acutispira (Tryon). Reg. No. 71218. Williamstown, Victoria.
Fig. 18. Ameria acutispira (Tryon) var. yarraensis (Ten. Woods). Type. After Hedley, Rec. Aust. Mus., xii, pl. 2, fig. 16. Upper Yarra, Victoria.
Fig. 19. Ameria acutispira (Tryon) var. etheridgii (Smith). After Smith, Journ. Linn. Soc. Lond., Zool., xvi, pl. 6, fig. 25. Yan Yean Reservoir, Victoria.
Fig. 20. Ameria acutispira (Tryon) var. tenuilirata (Smith). After Smith, Journ. Linn. Soc. Lond., Zool., xvi, pl. 6, fig. 27. Bunyip River, Victoria.
Fig. 21. Ameria producta (Smith). Reg. No. 70033. Wimmera River, Victoria.
Fig. 22 Isidorella newcombi (Adams and Angas). Reg. No. 71219. Meredith, Victoria.
Fig. 23. Isidorella newcombi (Adams and Angas) var. hedleyi (Clench). Reg. No. 71220. Cheltenham, Victoria.
Fig. 24. Isidorella newcombi (Adams and Angas) var. pilosa (Ten. Woods). Type. Reg. No. 35994. University Grounds, Melbourne, Victoria.
Fig. 25. Isidorella newcombi (Adams and Angas) var. crebreciliata (Ten. Woods). Type. Reg. No. 36028. Caulfield, near Melbourne, Victoria.
Fig. 26. Isidorella hainesii (Tryon). Reg. No. 71221. Bacchus Marsh, Victoria.

PLATE III.

Figs. 27, 27a, 27b. Planorbis tasmanicus Ten. Woods. Reg. No. 71222. Upper, Lower and side aspects. Tarraville, Victoria.
Figs. 28, 28a, 28b. Planorbis scottiana Johnston. Reg. No. 71223. Upper, lower and side aspects. Tarraville, Victoria.
Figs. 29, 29a, 29b. Planorbis waterhousei Clessin. Reg. No. 71224. Upper, lower and side aspects. Portland, Victoria.
Figs. 30, 30a, 30b. Segmentina victoriae Smith. Reg. No. 71225. Upper, lower and side aspects. River Yarra, near Botanic Gardens, Melbourne.
Figs. 31, 31a. Ancylus australicus Tate. Reg. No. 71226. Upper and side aspects. Tarraville, Victoria.
Figs. 32, 32a. Ancylus tasmanicus Ten. Woods. Reg. No. 71227. Upper and side aspects. Lorne, Victoria.
Fig. 33. Gundlachia petterdi Johnston. Reg. No. 71228. Blackburn Lake, Blackburn, Victoria.

Plate IV.

Fig. 34. Corbicula angasi Prime. Reg. No. 71229. Hamilton, Victoria.

Fig. 35. Sphaerium tasmanicum (Ten. Woods). Reg. No. 71230. Tarraville, Victoria.

Figs. 36, 36a, 36b. Sphaerium problematicum sp. nov. Type. Reg. No. 71231. External aspect; internal: *a* left valve; *b* right valve. Murray River, near Merbein, Victoria.

Fig. 37. Pisidium etheridgii Smith. Reg. No. 71232. Studley Park Reservoir, Melbourne.

Fig. 38. Hyridella australis (Lamarck). Reg. No. 71233. Diamond Creek, Victoria.

Fig. 39. Hyridella angasi (Reeve). Reg. No. 71234. Murray River, near junction of the Darling (Blandowski Collection).

Fig. 40. Propehyridella nepeanensis (Conrad). Reg. No. 71235. River Mitchell, Bairnsdale, Victoria.

Fig. 41. Propehyridella cultelliformis (Conrad). Reg. No. 71236. Tarra River, Victoria.

Fig. 42. Propehyridella narracanensis Cotton and Gabriel. Type. Reg. No. 71237. Thorpdale, Narracan River, Victoria.

Fig. 43. Protohyridella glenelgensis (Dennant). Type. Reg. No. 58615. Roseneath, Glenelg River, Victoria.

THE SILURIAN TRILOBITE *LICHAS AUSTRALIS.*

By Edmund D. Gill, B.A., B.D.

(Plate V.)

In the year 1876, McCoy (3) described the Trilobite *Lichas australis* from two distinct but incomplete cephala from the "junction of Woori Yallock and Yarra (Stewart's Station)." In the succeeding 63 years occasional cephala of this species have been collected, and also pygidia, which, because no other species of Victorian *Lichas* has been known, have been surmised to belong to *Lichas australis*. A complete carapace from Syme's Quarry, Killara, presented by Mrs. Robert Bowie, of Killara, to the National Museum, has now proved that surmise to be correct, and has made possible a full description of the species.

Order **OPISTHOPARIA** Beecher

Family **LICHADIDAE** Corda

Genus LICHAS Dalman

McCoy's description is as follows:

> "Width across glabella and middle of anterior lateral lobes, $\frac{5}{6}$ths of the length of the head, including neck-segment; middle portion of glabella tumid, broadly rounded in front, rather narrowed in the middle by the regular inward curvature of the anterior segmental furrows; anterior segmental lobes ovate, tumid; cheeks very tumid in an oblique line from the small eyes to the neck-segment, which is strongly marked and separated from base of glabella by a wide sulcus; surface covered by coarse unequal granulation of conical spinose tubercles; three conspicuous tubercles in sulcus at base of glabella. Length of head, 5 lines."

A supplementary description based on the complete carapace is given below.

Carapace ovate in outline, thin, tuberculate. Large cephalon and pygidium. Cephalon semi-circular. Neck-segment conspicuously wider than base of glabella. Free cheeks diminutive, apparently bearing genal spines. Eyes small and set on pedicels which contact with the antero-lateral corners of the fixed cheeks. Visual surface unknown. Pedicels high, more or less rounded in cross-section, tuberculate. When the cephalon is viewed from above, the pedicels are seen projecting at an angle of 45 degrees with the glabella. The posterior margin of the cephalon forms a straight line.

Thorax of eleven segments. A little longer than pygidium. Axial lobe wide, strongly arched. Pleura flat, tuberculate, produced into long spines.

Draws in a little at posterior end to accommodate itself to width of axial lobe of pygidium. Spines longer than pleurae proper; gradually tapering; directed slightly backwards and descending fairly steeply from the level of the pleural lobes, as in *Lichas palmata* Barrande.

Pygidium sub-semi-circular, tuberculate. Axial lobe elevated; conspicuously narrower than axial lobe of thorax; occupies about three-quarters of length of pygidium. Width fairly even until posterior end where it fades out in a broad V-shape. Annulations cross lobe transversely, those nearer the thorax being strong but those at the posterior end difficult to trace. Tubercles follow the annulations. Lateral lobes flat or lightly convex; each traversed by two prominent ribs, which make an angle of approximately 45 degrees with the axial lobe. Above, between, and below these ribs are faint ridges surmounted by tubercles. The pygidium has six short, stout spines, four being prolongations of the pleural ribs, and two projecting immediately below the axial lobe. The four lateral spines are directed backwards so as to make a more acute angle with the axial lobe than do the ribs.

Measurements of complete carapace: Length (including pygidial spines), 30 mm.; width (including pleural spines), 26 mm.

Apart from the structure of the cephalon, interesting and significant specializations in *Lichas australis* are noticeable in the tuberculate surface of the carapace, the spines which project from the lateral margins, and the elevation of the eyes on pedicels. The nature of the pleurae would allow a considerable degree of enrolment. All these characters have survival-value. The elevation of the eyes suggests a benthic habitat. The Lichadidae and the Odontopleuridae are the most specialized among the Opisthoparia. The high specialization, however, indicates a phylogerontic stage.

Another noteworthy feature of the species under discussion is its possession of eleven thoracic segments. Typically, the genus has (as McCoy points out) ten segments. Barrande's Bohemian species also have eleven segments, which number appears to be characteristic of them (1). Among the trilobites, as well as in other groups, there is a strong Bohemian element present in the Victorian Silurian fauna. Barrande's Bohemian species *Phacops fecundus* (in the slightly different form described by McCoy) is very abundant in the Victorian Yeringian.

Specific affinities.—McCoy (3) compared the present species with *Lichas haueri* Barrande, which occurs in Etages F and G of Bohemia. *Lichas australis* is altogether a smaller form than *L. haueri*. In addition to the lobar differences between these species mentioned by McCoy, the nature of the eye-pedicels and the occurrence of three instead of two prominent tubercles in the sulcus at the base of the glabella appear to be established divergences. The thorax of *L. haueri* was not known to Barrande. The pygidium of *L. australis* is

much shorter than that of Barrande's species, the central lobe is longer in proportion and is not produced into a median rib; the pleural ribs are not flat and wide but rounded and high; and the spines in which they terminate are stouter. *L. haueri* has no ridges between the lateral ribs.

Horizon.—Yeringian (Upper Silurian or Siluro-Devonian).

Localities.—Junction of Woori Yallock Creek and Yarra River; Syme's Tunnel, Killara; Syme's Quarry, Killara; Syme's Homestead, Killara; Warburton Road, Killara (a little east of turn-off to Killara Railway Station). All these localities are proximate to one another. Apropos of the last-named locality, it is worthy of note that in 1913 Dr. J. S. Green presented a complete but distorted trilobite collected at this place to the Museum. It was at that time determined as *Odontopleura* sp., and was later recorded as such (2), but it must now be referred to *L. australis*. A pygidium of *L. australis* has been collected from the same locality, the published reference to which is "between Killara and Woori Yallock" (2).

Associates.—The following trilobites are associated with *Lichas australis*: *Calymene blumenbachi* (Brongniart), *Cheirurus sternbergi* (Boeck), *Cyphaspis* sp., *Dalmanites meridianus* (Etheridge and Mitchell), *Odontopleura jenkinsi* Eth. and Mitch., *O. rattei* Eth. and Mitch., *Phacops crosslei* Eth. and Mitch., *P. fecundus* McCoy non Barrande, *P. latigenalis* Eth. and Mitch., *P. serratus* Foerste.

The writer wishes to thank Mr. L. S. G. Butler for the photograph of the trilobite described.

References

1. Barrande, J. "Systême Silurien du Centre de la Bohême." Praguer, Paris, 1852.
2. Gill, E. D. Yeringian Trilobites, Vict. Nat., Vol. LIV, Feb., 1938, pp. 167-71, 4 figs.
3. McCoy, F. Prodromus of the Palaeontology of Victoria, Decade III, p. 18, pl. 12, fig. 11. Geol. Surv. Vict., 1876.

Description of Plate V

1. *Lichas australis* McCoy, ×4 approx. Complete carapace from Syme's Quarry, Killara. Reg. No. 14,087.
2. *L. australis.* Cephalon showing eye pedicel from Syme's Tunnel, Killara; magnified. Reg. No. 14,088.

SOME PREHISTORIC ARTEFACTS FROM THE TERRITORY OF NEW GUINEA.

By D. A. Casey,
Hon. Ethnologist.

Plate VI.

The National Museum has recently received the five artefacts described below. The three obsidian implements are from the Rev. Father Neuhaus, M.S.C., and the stone figure of a bird and the carved stone axe were brought to the Museum for examination by E. W. P. Chinnery, formerly Director of District Services, Territory of New Guinea.

Carved Stone Bird

From the Wahgi Valley, about 40 miles W. of Chimbu Station, Fig. 1 and Plate VI.

The figure measures $4\frac{3}{4}$ inches wide, $3\frac{3}{4}$ inches high, and $3\frac{3}{4}$ inches long. It is made of moderately coarse-grained volcanic rock of andesitic type. The surface is considerably patinated. The wings are extended sideways and downwards. The legs, which are widely spaced, are rather stout and of circular section. They appear to have been broken off short, as their under surfaces are not flat. The face and beak have been broken off. The bird is finely made, and is gracefully

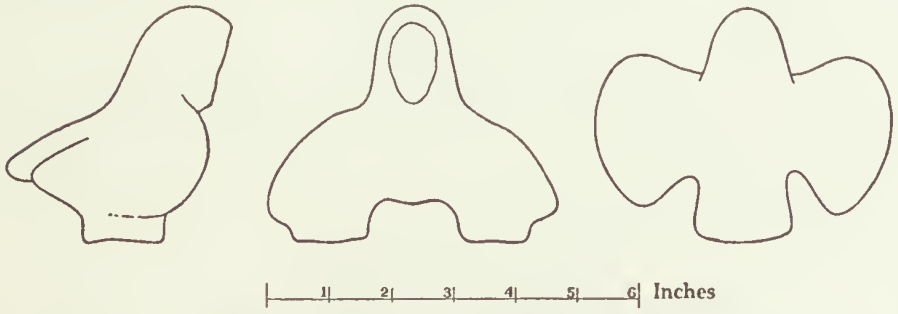

Fig. 1. Stone Bird, Wahgi Valley.

shaped and proportioned in smooth flowing lines. It was found by natives while digging garden land. Like all other prehistoric artefacts from New Guinea, the present natives have no knowledge of its origin or significance. Now in the possession of E. W. P. Chinnery.

Among the prehistoric carved stonework from New Guinea (1) and the adjacent islands, several other bird figures are known.

(a) From Aikora River Goldfield, Papua (2). An elongated figure of a bird which forms the handle of a pestle; the extended wings, stretched outwards and downwards, are similar to those of the Wahgi Valley bird, and the long curved neck and long single leg are circular in section. Found under 10 feet of alluvial sand and clay. British Museum.

(b) From New Ireland (3). A rather massive conventionalized figure of a bird, with folded wings, standing on a single central leg of circular section. It is said to have been used during sacred ceremonies of the Ingiet Society. National Museum, Melbourne.

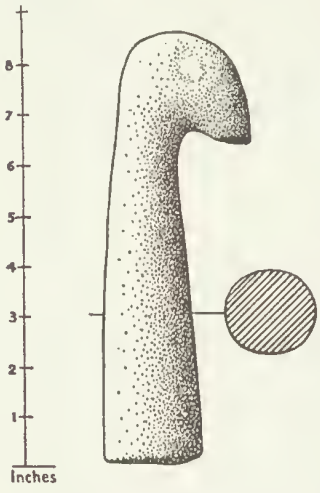

Fig. 2. Stone Bird's Head, Papua.

(c) From the Waitut River, Territory of New Guinea (4, 5). A crude head and neck only. Australian Museum, Sydney.

(d) From Papua, locality unknown, Fig. 2. A head with elongated neck, broken off at its lowest end. Made from volcanic rock, heavily patinated. The eyes are formed by raised bosses similar in shape to the eyes on the axe from Bougainville described hereunder. Australian Institute of Anatomy, Canberra.

(e) From the Wahgi Valley (5). A mortar with four lateral projections, one of which is in the form of a bird's head. Australian Museum, Sydney.

(f) From the Wahgi Valley (5). A bowl, the outer surface carved in relief with bird-like figures. Australian Museum, Sydney.

(g) From Bougainville Island. The carved birds' heads on the axe described hereunder.

Carved Stone Axe

From Toiminapo Plantation, S.E. coast of Bougainville Island. Fig. 3 and Plate VI.

On both top and bottom of the body of the axe there is a projection in the shape of the head and neck of a bird. Across each side of the axe is a line of six raised bosses, the end ones forming the bird's eyes. The bosses which form the eyes are sub-cylindrical in form, and appear to have been shaped by grinding with a hollow cylindrical drill. An

enlargement on the butt end is serrated by a number of grooves and notches. Just forward of the bird's head projec-

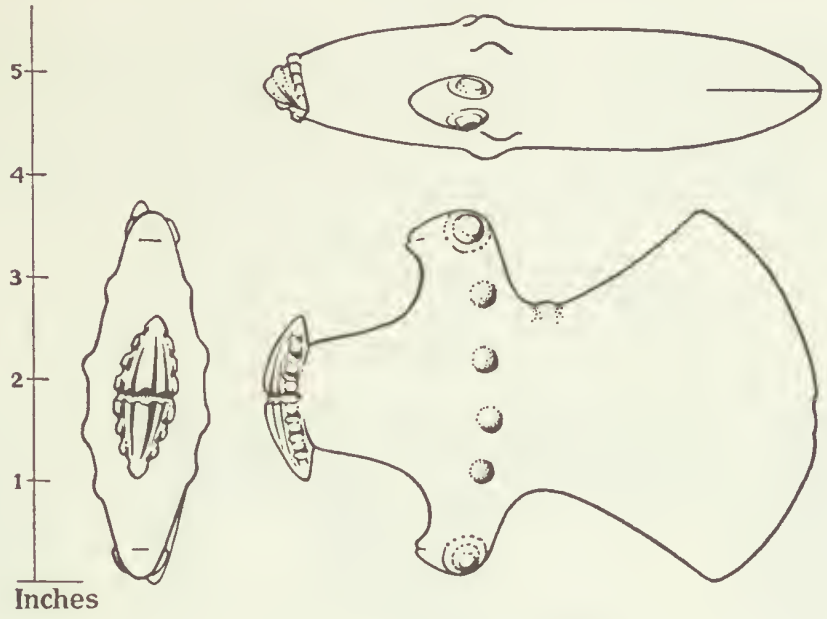

Fig. 3. Stone Axe, Bougainville Island.

tions, the body of the axe shows faint grooving, which seems to have been worn by a binding. Rabaul Museum, T.N.G.

The axe is unique, and its use is unknown. Except for the grooving, there is no indication as to how it could have been hafted.

The axe is made of a similar type of stone to that used for the stone bird described above. The surface is considerably patinated.

The bird motif and the decorative raised bosses indicate that it is related to the prehistoric stone mortar culture of New Guinea, as both these features are found on the stone mortars and pestles.

Obsidian Fish Hook

From Lihir Island, off the east coast of New Ireland. National Museum, Melbourne. Reg. No. 43303. Fig. 4.

The implement was found at Kiata, near the south point of the island, at a spot about 200 yards from the shore where the ground over a subterranean watercourse had sunk, exposing the hook, which was nearly a foot below the surface. It was brought to Father Neuhaus by the native who discovered it.

Although Lihir is a volcanic Island, obsidian is not found there.

The implement, which measures $7\frac{3}{8}$ by $5\frac{5}{8}$ inches, is made from a large flake. The secondary chipping has been done from both front and back, so that the edge is in the medial plane. The bulb of percussion has been removed, but was approximately at the point A in Fig. 4. The side B-C has been formed by a single fracture which is not an accidental break, since it would be impossible to break the flake here

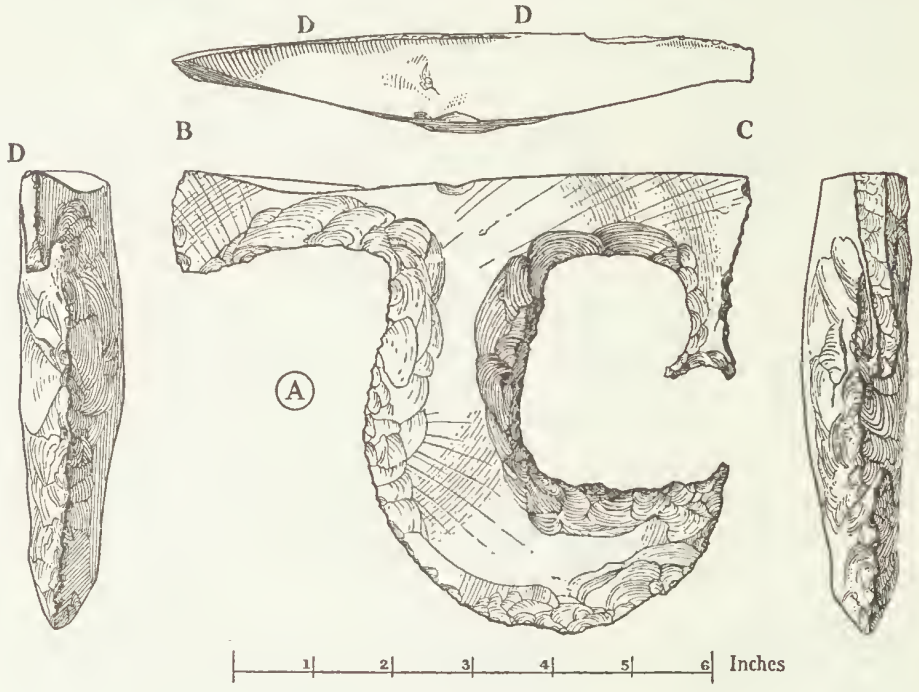

Fig. 4. Obsidian Fish-hook, Lihir Island.

after the hook had been shaped. The sharp upturned edge of the fracture has been slightly trimmed down at D-D.

That this remarkable artifact is indeed a fish-hook, is clearly shown by its similarity in form to certain fish-hooks from the Carolines. Fig. 5 shows three types of hook used at Nukuor, a small island south of the Mortlock group. Nos. 1 (6) and 2 (7) are of pearl shell and are of a type peculiar to this island. Nos. 3 (7) and 4 (8) are of turtle shell, and are types which were used also in other parts of the Carolines. Although it is much larger, the Lihir hook is strikingly similar in form to Nos. 1 and 2. These latter, however, lack the projection opposite the point, but such a projection (the lug to which the line is attached) is present in the other two types. In

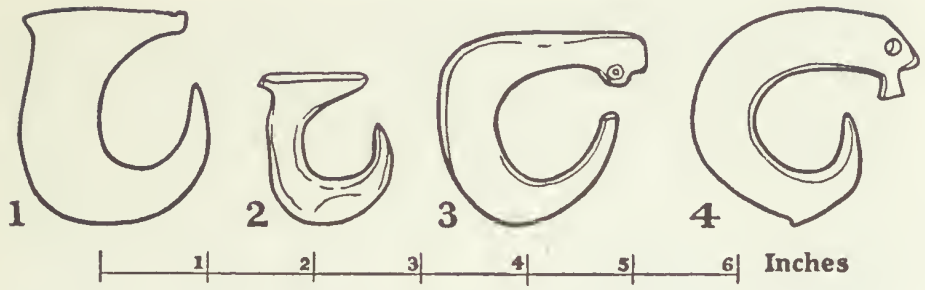

FIG. 5. TYPES OF HOOKS USED AT NUKUOR, CAROLINE ISLANDS.
(After Finsch, Eilers, and Beasley.)

each case the line runs to the right of the hook, as drawn. In Nos. 1 and 2 it is attached by binding it along the flat side of the hook.

Only one other obsidian fish-hook (Fig. 6) is known (9). It was found in the interior of the island of Manus, on ground that had been cleared of timber. It is of large size (9 x 7½ inches) and is similar in form to the simple one-piece hooks

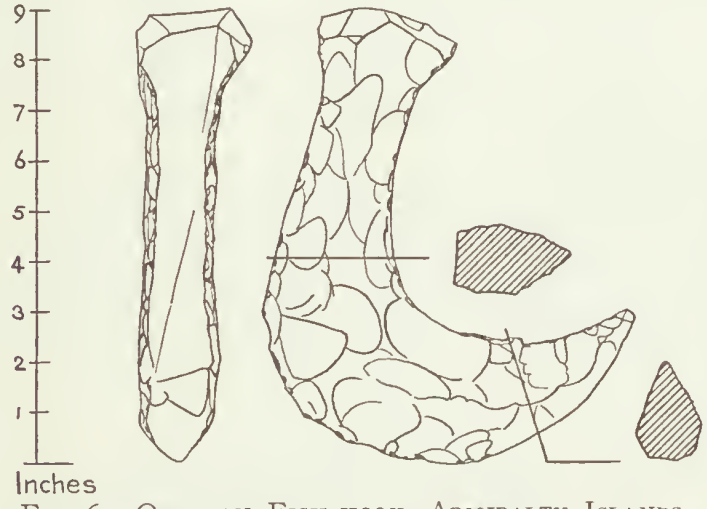

FIG. 6. OBSIDIAN FISH-HOOK, ADMIRALTY ISLANDS.
From photographs supplied by Dr. Alfred Bühler, Museum für Volgerkunde, Basel.

widely distributed in the Pacific. It has been shaped by secondary chipping from both front and back. The back of the hook has been formed by a single fracture.

The only other places in the Pacific where stone fish hooks are found are Easter Island and New Zealand. The Easter Island hooks were made of a close-grained hard stone, shaped by drilling and grinding. Some of them at least, from their apparently impracticable form, seem to have been made for

ceremonial purposes only. In New Zealand, a highly conventionalized greenstone hook (*hei matau*) was used in rites to ensure success in important fishing expeditions, and also as a personal ornament. The *hei matau* can probably be identified as the hook of Maui, who in Polynesian legend pulled the land up out of the ocean with a hook. This legend, or variants of it, is found throughout Polynesia. As well as these stone hooks, ceremonial hooks of other materials (wood, bone and shell) are found at several places in the Pacific.

As the Lihir and Manus hooks are made from such comparatively brittle material, it is probable that they were used only for ceremonial or ritual purposes. In their form, however, there is nothing to suggest that they are types which have lost their utility and become conventionalized. In this regard it should be remembered that many primitive hooks were not intended to be penetrative, like the modern hook, but were merely bait-holders. Those shown in Fig. 5 are in this class.

Obsidian Blade Implement

From the District of Talasea, New Britain. National Museum, Melbourne. Reg. No. 43304. Fig. 7a.

The circumstances of the finding of this implement are not known, but it was collected in the District of Talasea by Father Schumm.

It has been made from a long parallel-sided flake, of remarkable symmetry, struck from a prepared core. The flake has been fractured at one end and, as in the case of the Lihir hook, the sharp upturned edge of the fracture has been slightly trimmed down. The "handle" end has been shaped by secondary chipping from both front and back. The function or use of the implement is not known.

Chipping from both front and back, so that the edge is in the medial plane, is a specialized technique requiring considerable skill. Apart from the three implements described, only one other example of this technique is known from the Western Pacific; a large obsidian axe from the Yodda Valley, Papua (10). The rarity of such artefacts clearly shows them to be ancient, and their technique indicates that they all probably belong to the same culture.

Seligman (11) has called attention to the similarity in form and material between the Yodda Valley axe and the obsidian spearheads of Easter Island, and has suggested that they may possibly be related. Metraux (12), however, has pointed out that the great distance separating the two localities and the

fact that no obsidian occurs between them make relationship extremely improbable. The Easter Island spearheads are certainly chipped from both front and back, but they are of crude workmanship and extremely simple form. A tang is formed on a flake by the simple method of making two

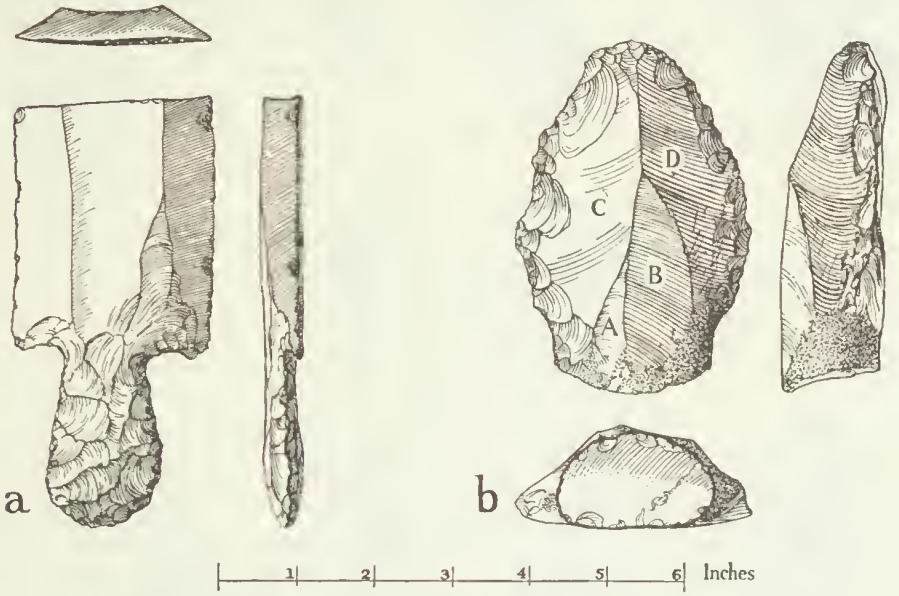

Fig. 7. (a) Obsidian Implement, Talasea, New Britain.
(b) Obsidian Point, Lihir Island.

notches on its side. Although it is fundamentally the same, the technique employed cannot be compared with the skilled workmanship of the Yodda Valley axe and the other examples described herein.

Obsidian Point

From Lihir Island. National Museum, Melbourne. Reg. No. 43305. Fig. 7b.

When the obsidian hook described above was found, Father Neuhaus asked the natives to look out for any similar artifacts. Shortly afterwards a native brought to him an obsidian point which had been found in a river not very far (about half an hour's walk) from the place where the hook was discovered.

The implement is made from a flake. The base end has been shaped to a roughly oval section by hammer dressing. The base has been fractured, probably after manufacture, as the hammer dressing goes right up to the edge of the fracture.

Superficially the implement resembles the obsidian flake spearheads from the island of Manus. It has, however, been made in quite a different way. In the Manus spearheads the primary flakes are all struck from the same direction (i.e., from the base, towards the point). In this case, the flake from which the implement is made has been struck from the direction of the base, as have also flakes A and B, in Fig. 7b, but flakes C and D have been struck from the opposite direction.

This implement is the only known example of hammer-dressed obsidian.

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Description of Plate VI

1. Stone Bird, Wahgi Valley, Territory of New Guinea.
2. Stone Axe, Bougainville Island.

Brown, Prior, Anderson Pty. Ltd., 430 Little Bourke St., Melbourne, C.1.

Freshwater Mollusca of Victoria

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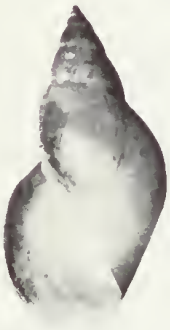

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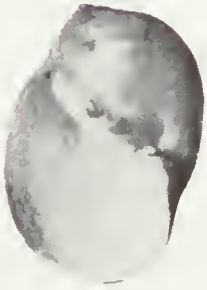

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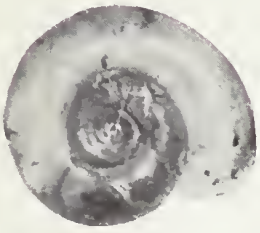
Freshwater Mollusca of Victoria



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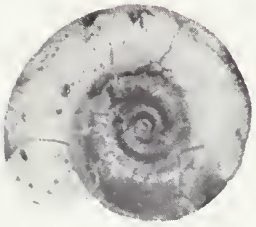

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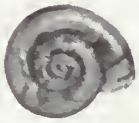

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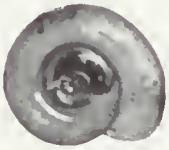

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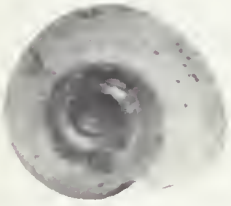

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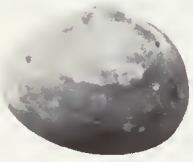
Freshwater Mollusca of Victoria



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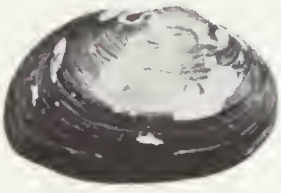

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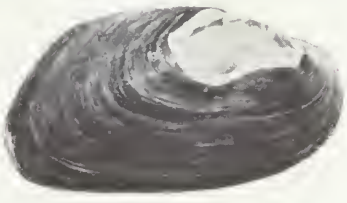

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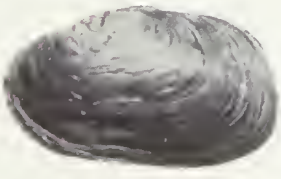

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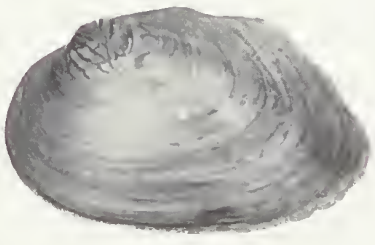

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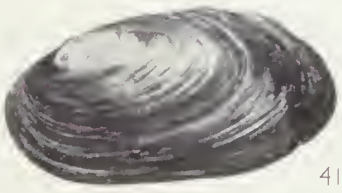

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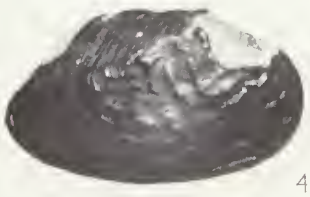

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Freshwater Mollusca of Victoria

1. Complete carapace, Syme's Quarry, Killara, ×4.

2. Cephalon showing eye pedicel, Syme's Tunnel, Killara. (Magnified.)

Lichas australis McCoy; a Silurian Trilobite.

1. Stone Bird, Wahgi Valley.

2. Stone Axe, Bougainville Island.

Prehistoric Artefacts, Territory of New Guinea.